

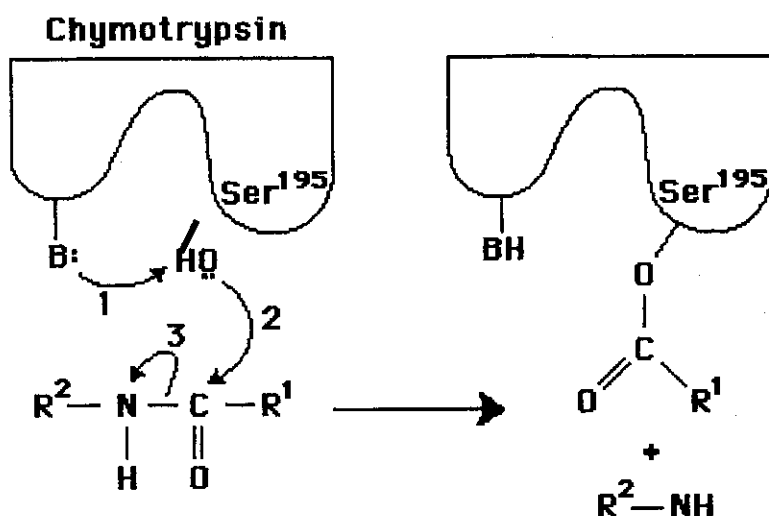
編號: E 428 系所: 生物化學暨分子生物學研究所甲組 科目: 生物化學

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

※考生答題注意事項; 請務必依題號順序於答案卷上作答, 否則不予計分。答題方式請於答案卷上「由上而下」作答, 先書寫題號後接答案。

一、選擇題: 1-40 題、每題二分、均為單選題; 共八十分。

1. A compound has a pK_a of 7.4. To 100 mL of a 1.0 M solution of this compound at pH 8.0 is added 30 mL of 1.0 M hydrochloric acid. The resulting solution is pH:
 - A. 6.5
 - B. 6.8
 - C. 7.2
 - D. 7.4
 - E. 7.5
2. Phosphoric acid is tribasic, with pK_a 's of 2.14, 6.86, and 12.4. The ionic form that predominates at pH 3.2 is:
 - A. H_3PO_4 .
 - B. $H_2PO_4^-$.
 - C. HPO_4^{2-} .
 - D. PO_4^{3-} .
 - E. none of the above.
3. In the following diagram of the first step in the reaction catalyzed by the protease chymotrypsin, the process of general base catalysis is illustrated by the number _____, and the process of covalent catalysis is illustrated by the number _____.



(背面仍有題目, 請繼續作答)

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- A. 1; 2
B. 1; 3
C. 2; 3
D. 2; 3
E. 3; 2
4. Myoglobin and the subunits of hemoglobin have:
- A. no obvious structural relationship.
B. very different primary and tertiary structures.
C. very similar primary and tertiary structures.
D. very similar primary structures, but different tertiary structures.
E. very similar tertiary structures, but different primary structures.
5. An allosteric interaction between a ligand and a protein is one in which:
- A. binding of a molecule to a binding site affects binding properties of another site on the protein.
B. binding of the ligand to the protein is covalent.
C. multiple molecules of the same ligand can bind to the same binding site.
D. binding of a molecule to a binding site affects binding of additional molecules to the same site.
E. two different ligands can bind to the same binding site.
6. Which of the following statements about a plot of V_0 vs. $[S]$ for an enzyme that follows Michaelis-Menten kinetics is *false*?
- A. As $[S]$ increases, the initial velocity of reaction V_0 also increases.
B. K_m is the $[S]$ at which $V_0 = 1/2 V_{max}$.
C. The shape of the curve is a hyperbola.
D. The y-axis is a rate term with units of $\mu\text{m}/\text{min}$.
E. At very high $[S]$, the velocity curve becomes a horizontal line that intersects the y-axis at K_m .
7. In glycoproteins, the carbohydrate moiety is always attached through the amino acid residues:
- A. asparagine, serine, or threonine.
B. aspartate or glutamate.
C. glutamine or arginine.
D. glycine, alanine, or aspartate.
E. tryptophan, aspartate, or cysteine.

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8. Restriction enzymes:
- A. act at the membrane to restrict the passage of certain molecules into the cell.
 - B. are highly specialized ribonucleases that degrade mRNA soon after its synthesis.
 - C. are sequence-specific DNA endonucleases.
 - D. are very specific proteases that cleave peptides at only certain sequences.
 - E. catalyze the addition of a certain amino acid to a specific tRNA.
9. A convenient cloning vector with which to introduce foreign DNA into *E. coli* is a(n):
- A. *E. coli* chromosome.
 - B. messenger RNA.
 - C. plasmid.
 - D. yeast "ARS" sequence.
 - E. yeast transposable element.
10. Which one of the following analytical techniques does *not* help illuminate a gene's cellular function?
- A. Southern blotting
 - B. DNA microarray analysis
 - C. Protein chip analysis
 - D. Two-dimensional gel electrophoresis
 - E. Two-hybrid analysis
11. Sphingosine is *not* a component of:
- A. cardiolipin.
 - B. ceramide.
 - C. cerebrosides.
 - D. gangliosides.
 - E. sphingomyelin.
12. The ion channel that opens in response to acetylcholine is an example of a _____ signal transduction system.
- A. G protein
 - B. ligand-gated
 - C. receptor-enzyme
 - D. serpentine receptor
 - E. voltage-gated

(背面仍有題目,請繼續作答)

編號： 428 系所：生物化學暨分子生物學研究所甲組 科目：生物技術概論

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13. Hormone-activated phospholipase C can convert phosphatidylinositol 4,5-bisphosphate to:
- diacylglycerol + inositol triphosphate.
 - diacylglycerol + inositol + phosphate.
 - glycerol + inositol + phosphate.
 - glycerol + phosphoserine.
 - phosphatidyl glycerol + inositol + phosphate.
14. Hydrolysis of 1 M glucose 6-phosphate catalyzed by glucose 6-phosphatase is 99% complete at equilibrium (i.e., only 1% of the substrate remains). Which of the following statements is most nearly correct? ($R = 8.315 \text{ J/mol}\cdot\text{K}$; $T = 298 \text{ K}$; $\log 100 = 2$, $\ln 100 = 4.6$, $\log 0.01 = -2$, and $\ln 0.01 = -4.6$)
- $\Delta G^\circ = -11 \text{ kJ/mol}$
 - $\Delta G^\circ = -5 \text{ kJ/mol}$
 - $\Delta G^\circ = 0 \text{ kJ/mol}$
 - $\Delta G^\circ = +11 \text{ kJ/mol}$
 - ΔG° cannot be determined from the information given.
15. Which of the following is *not* an intermediate of the citric acid cycle?
- Acetyl-coA
 - Citrate
 - Oxaloacetate
 - Succinyl-coA
 - α -Ketoglutarate
16. Pyridoxal phosphate is a cofactor in this class of reactions:
- acetylation.
 - desulfuration.
 - methylation.
 - reduction.
 - transamination.
17. Oxidative phosphorylation and photophosphorylation share all of the following *except*:
- chlorophyll.
 - involvement of cytochromes.
 - participation of quinones.
 - proton pumping across a membrane to create electrochemical potential.
 - use of iron-sulfur proteins.

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18. Which of these enzymes is *not* regulated by light in the chloroplast?
- Fructose 1,6-bisphosphatase
 - Glyceraldehyde-phosphate dehydrogenase
 - glycogen phosphorylase
 - Ribulose 5-phosphate kinase
 - Sedoheptulose 1,7-bisphosphatase
19. Which of the following is a DNA sequence?
- Coactivator
 - Corepressor
 - Enhancer
 - Inducer
 - Transactivator
20. A certain bacterial mRNA is known to represent only one gene and to contain about 800 nucleotides. If you assume that the average amino acid residue contributes 110 to the peptide molecular weight, the largest polypeptide that this mRNA could code for would have a molecular weight of about:
- 800.
 - 30,000.
 - 5,000.
 - 80,000.
 - An upper limit cannot be determined from the data given.
21. "Footprinting" or DNase protection is a technique used to identify:
- a region of DNA that has been damaged by mutation.
 - E. coli* cells that contain a desired, cloned piece of DNA.
 - the position of a particular gene of a chromosome.
 - the position of internally double-stranded regions in a single-stranded DNA molecule.
 - the specific binding site of a repressor, polymerase, or other protein on the DNA.
22. Which of these statements about hydrogen bonds is *not* true?
- Hydrogen bonds account for the anomalously high boiling point of water.
 - In liquid water, the average water molecule forms hydrogen bonds with three to four other water molecules.
 - Individual hydrogen bonds are much weaker than covalent bonds.
 - Individual hydrogen bonds in liquid water exist for many seconds and sometimes for minutes.
 - The strength of a hydrogen bond depends on the linearity of the three atoms involved in the bond.

(背面仍有題目,請繼續作答)

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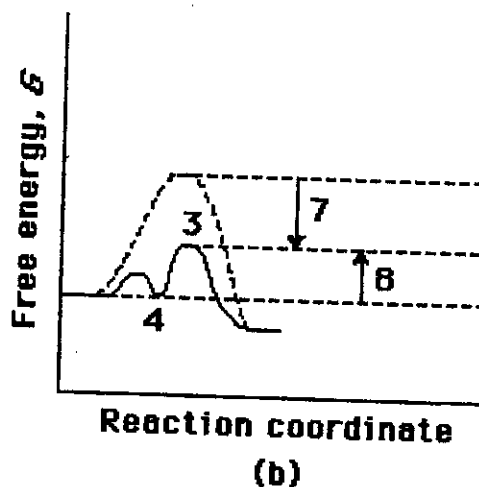
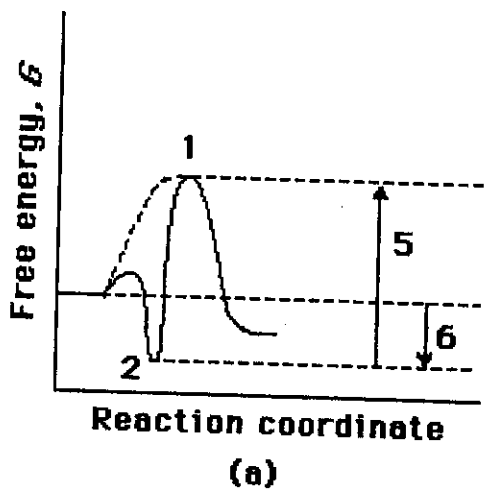
23. Experiments on denaturation and renaturation after the reduction and reoxidation of the —S—S— bonds in the enzyme ribonuclease (RNase) have shown that:

- A. folding of denatured RNase into the native, active conformation, requires the input of energy in the form of heat.
- B. native ribonuclease does not have a unique secondary and tertiary structure.
- C. the completely unfolded enzyme, with all —S—S— bonds broken, is still enzymatically active.
- D. the enzyme, dissolved in water, is thermodynamically stable relative to the mixture of amino acids whose residues are contained in RNase.
- E. the primary sequence of RNase is sufficient to determine its specific secondary and tertiary structure.

24. A monoclonal antibody differs from a polyclonal antibody in that monoclonal antibodies:

- A. are labeled with chemicals that can be visualized.
- B. are produced by cells from the same organism that produced the antigen.
- C. are synthesized by a population of identical, or "cloned," cells.
- D. are synthesized only in living organisms.
- E. have only a single polypeptide chain that can recognize an antigen.

25. 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).

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26. An enzyme-catalyzed reaction was carried out with the substrate concentration initially a thousand times greater than the K_m for that substrate. After 9 minutes, 1% of the substrate had been converted to product, and the amount of product formed in the reaction mixture was 12 μmol . If, in a separate experiment, one-third as much enzyme and twice as much substrate had been combined, how long would it take for the same amount (12 μmol) of product to be formed?
- A. 1.5 min
B. 13.5 min
C. 27 min
D. 3 min
E. 6 min
27. Which of the following statements about starch and glycogen is *false*?
- A. Amylose is unbranched; amylopectin and glycogen contain many ($\alpha 1 \rightarrow 6$) branches.
B. Both are homopolymers of glucose.
C. Both serve primarily as structural elements in cell walls.
D. Both starch and glycogen are stored intracellularly as insoluble granules.
E. Glycogen is more extensively branched than starch.
28. For the oligoribonucleotide pACGUAC:
- A. the nucleotide at the 3' end has a phosphate at its 3' hydroxyl.
B. the nucleotide at the 3' end is a purine.
C. the nucleotide at the 5' end has a 5' hydroxyl.
D. the nucleotide at the 5' end has a phosphate on its 5' hydroxyl.
E. the nucleotide at the 5' end is a pyrimidine.
29. In the Watson-Crick model of DNA structure:
- A. both strands run in the same direction, 3' \rightarrow 5'; they are parallel.
B. phosphate groups project toward the middle of the helix, where they are protected from interaction with water.
C. T can form three hydrogen bonds with either G or C in the opposite strand.
D. the distance between the sugar backbone of the two strands is just large enough to accommodate either two purines or two pyrimidines.
E. the distance between two adjacent bases in one strand is about 3.4 \AA .

(背面仍有題目,請繼續作答)

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30. In the laboratory, recombinant plasmids are commonly introduced into bacterial cells by:
- electrophoresis – a gentle low-voltage gradient draws the DNA into the cell.
 - infection with a bacteriophage that carries the plasmid.
 - microinjection.
 - mixing plasmids with an extract of broken cells.
 - transformation – heat shock of the cells incubated with plasmid DNA in the presence of CaCl_2 .
31. Which of the following statements about the polymerase chain reaction (PCR) is *false*?
- DNA amplified by PCR can be cloned.
 - DNA is amplified at many points within a cellular genome.
 - Newly synthesized DNA must be heat-denatured before the next round of DNA synthesis begins.
 - The boundaries of the amplified DNA segment are determined by the synthetic oligonucleotides used to prime DNA synthesis.
 - The technique is sufficiently sensitive that DNA sequences can be amplified from a single animal or human hair.
32. Which of these statements is generally true of integral membrane proteins?
- A hydropathy plot reveals one or more regions with a high hydropathy index.
 - The domains that protrude on the cytoplasmic face of the plasma membrane nearly always have covalently attached oligosaccharides.
 - They are unusually susceptible to degradation by trypsin.
 - They can be removed from the membrane with high salt or mild denaturing agents.
 - They undergo constant rotational motion that moves a given domain from the outer face of a membrane to the inner face and then back to the outer.
33. For the process of solute transport, the constant K_t is:
- analogous to K_a for ionization of a weak acid.
 - analogous to K_m for an enzyme-catalyzed reaction.
 - analogous to V_{\max} for an enzyme reaction
 - proportional to the number of molecules of glucose transporter per cell.
 - the maximum rate of glucose transport.
34. Which of the following statements concerning signal transduction by the insulin receptor is *not* correct?
- Activation of the receptor protein kinase activity results in the activation of additional protein kinases.
 - Binding of insulin to the receptor activates a protein kinase.

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- C. Binding of insulin to the receptor results in a change in its quaternary structure.
D. The receptor protein kinase activity is specific for tyrosine residues on the substrate proteins.
E. The substrates of the receptor protein kinase activity are mainly proteins that regulate transcription.
35. Steroid hormones are carried on specific carrier proteins because the hormones:
- A. are too unstable to survive in the blood on their own.
B. cannot dissolve readily in the blood because they are too hydrophobic.
C. cannot find their target cells without them.
D. need them in order to pass through the plasma membrane.
E. require subsequent binding to specific receptor proteins in the nucleus.
36. E° of the NAD^+/NADH half reaction is -0.32 V . The E° of the oxaloacetate/malate half reaction is -0.175 V . When the concentrations of NAD^+ , NADH , oxaloacetate, and malate are all 10^{-5} M , the "spontaneous" reaction is:
- A. Oxaloacetate + $\text{NADH} + \text{H}^+ \rightarrow \text{malate} + \text{NAD}^+$.
B. Malate + $\text{NAD}^+ \rightarrow \text{oxaloacetate} + \text{NADH} + \text{H}^+$.
C. Malate + $\text{NADH} + \text{H}^+ \rightarrow \text{oxaloacetate} + \text{NAD}^+$.
D. $\text{NAD}^+ + \text{NADH} + \text{H}^+ \rightarrow \text{malate} + \text{oxaloacetate}$.
E. $\text{NAD}^+ + \text{oxaloacetate} \rightarrow \text{NADH} + \text{H}^+ + \text{malate}$.
37. Glucose breakdown in certain mammalian and bacterial cells can occur by mechanisms other than classic glycolysis. In most of these, glucose 6-phosphate is oxidized to 6-phosphogluconate, which is then further metabolized by:
- A. an aldolase-type split to form glyceric acid and glyceraldehyde 3-phosphate.
B. an aldolase-type split to form glycolic acid and erythrose 4-phosphate.
C. decarboxylation to produce keto- and aldopentoses.
D. conversion to 1,6-bisphosphogluconate.
E. oxidation to a six-carbon dicarboxylic acid.
38. Which of the following is *not* true of the citric acid cycle?
- A. All enzymes of the cycle are located in the cytoplasm, except succinate dehydrogenase, which is bound to the inner mitochondrial membrane.
B. In the presence of malonate, one would expect succinate to accumulate.
C. Oxaloacetate is used as a substrate but is not consumed in the cycle.
D. Succinate dehydrogenase channels electrons directly into the electron transfer chain.
E. The condensing enzyme is subject to allosteric regulation by ATP and NADH.

(背面仍有題目,請繼續作答)

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39. Which of the following is (are) true of the oxidation of 1 mol of palmitate (a 16-carbon saturated fatty acid; 16:0) by the β -oxidation pathway, beginning with the free fatty acid in the cytoplasm?

1. Activation of the free fatty acid requires the equivalent of two ATPs.
2. Inorganic pyrophosphate (PP_i) is produced.
3. Carnitine functions as an electron acceptor.
4. 8 mol of $FADH_2$ are formed.
5. 8 mol of acetyl-CoA are formed.
6. There is no direct involvement of NAD^+ .

- A. 1 and 5 only
- B. 1, 2, and 5
- C. 1, 2, and 6
- D. 1, 3, and 5
- E. 5 only

40. Which of these amino acids are *both* ketogenic and glucogenic?

1. Isoleucine; 2. Valine; 3. Histidine; 4. Arginine; 5. Tyrosine

- A. 1 and 5
- B. 1, 3, and 5
- C. 2 and 4
- D. 2, 3, and 4
- E. 2, 4, and 5

二、簡答題：41-42 題，共 20 分

41. Please write down the key words best defined by each description of the followings: (2% each)

Note: Don't exceed three words in each description!

- A. The randomness or disorder of the components of a chemical system
- B. A type of macromolecules combining with lipids to form several classes of lipoprotein particles, spherical complexes with hydrophobic lipids in the core and hydrophilic amino acid side chains at the surface.
- C. The type of processing reactions altering some newly made proteins, both prokaryotic and eukaryotic, to attain their final biologically active conformations.
- D. The effect of pH and CO_2 concentration on the binding and release of oxygen by hemoglobin

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E. A sensitive diagnostic biochemical measurement on blood and urine samples which is essential in the diagnosis and treatment of diabetes. For example, the patient fasts overnight, then drinks a test dose of 100 g of glucose dissolved in a glass of water. The blood glucose concentration is measured before the test dose and at 30 min intervals for several hours thereafter.

42. Please draw the Lineweaver-Burk plots to briefly describe the three types of reversible enzyme inhibitions. Use three different concentrations of inhibitor (including $[I]=0$) to indicate what the line-interception terms (values) on the $1/V_0$ axis and on the $1/[S]$ axis are and how K_m and V_{max} change their values (increased, decreased, or unchanged). (3% ~~each~~ for (a) & (b), 4% for (C))

(a) Competitive inhibition; (b) Non-competitive inhibition; (c) Un-competitive inhibition.