

上海科技大学 2018 年攻读硕士学位研究生

招生考试试题

科目代码： 641 科目名称：生物化学与分子生物学

考生须知：

1. 本试卷满分为 150 分，全部考试时间总计 180 分钟。
 2. 所有答案必须写在答题纸上，写在试题纸上或草稿纸上均无效。
 3. 每道题目的中文部分均已翻译为英文，考生可在中英文中任选一种语言作答。
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一、名词解释（每小题 5 分，共 20 分）

1. 流动镶嵌模型（Fluid mosaic model）
2. 糖酵解（Glycolysis）
3. 基因组编辑（Genome editing）
4. 增强子（Enhancer）

二、单选题（每小题 1 分，共 20 分）

1. 规则的二级结构解折叠将导致（The unfolding of regular secondary structure causes）：（ ）
 - A. 蛋白质熵的轻微增加（Little increase in the entropy of protein）
 - B. 蛋白质熵的大量降低（Large decrease in the entropy of the protein）
 - C. 蛋白质的熵不变（No change in the entropy of the protein）
 - D. 蛋白质熵的大量增加（Large increase in the entropy of the protein）
 2. 甘氨酸的分子式是 $C_2H_5O_2N$ 。通过缩合反应形成的甘氨酸线性寡聚体的分子式应该是下面哪个（The molecular formula for glycine is $C_2H_5O_2N$. What would be the molecular formula for a linear oligomer made by linking ten glycine molecules together by condensation synthesis）：（ ）
 - A. $C_{20}H_{50}O_{20}N_{10}$
 - B. $C_{20}H_{32}O_{11}N_{10}$
 - C. $C_{20}H_{40}O_{10}N_{10}$
 - D. $C_{20}H_{68}O_{29}N_{10}$
 3. 肽链延伸时，tRNA 在核糖体上的移动路线是（The pathway of a tRNA during polypeptide elongation on the ribosome is）：（ ）
 - A. A 位点 → P 位点 → E 位点（A site → P site → E site）
 - B. P 位点 → 进入位点 → 脱离位点（P site → entry site → exit site）
 - C. A 位点 → P 位点 → 进入位点（A site → P site → entry site）
 - D. P 位点 → A 位点 → E 位点（P site → A site → E site）
 4. 肽聚糖是复合物，它包含（Peptidoglycan is a complex that contains）：（ ）
 - A. 寡聚糖和蛋白（Oligo-saccharide and protein）
 - B. 多聚糖和蛋白（Poly-saccharide and protein）
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- C. 单糖和蛋白 (Mono-saccharide and protein)
D. 氨基酸和碳水化合物 (Amino acid and carbohydrate)
5. 下面哪些属于丝氨酸蛋白酶 (Which of the following (s) is/are serine proteases): ()
A. 胰凝乳蛋白酶 (Chymotrypsin)
B. 胰蛋白酶 (Trypsin)
C. 弹性蛋白酶 (Elastase)
D. 上面所有的 (All above ones)
6. 以下选项中哪个不属于 RNA 的基本结构 (Which of the following component is NOT belonged to the basic structure of RNA): ()
A. 碱基 (Base)
B. 脱氧核糖 (Deoxyribose)
C. 磷酸二酯键 (Phosphodiester bond)
D. 糖苷键 (Glycosidic bond)
7. 以下哪种代谢物能引起痛风 (Which of the following metabolite can cause gout): ()
A. 尿酸 (Uric acid)
B. 尿素 (Urea)
C. 黄嘌呤 (Xanthine)
D. 次黄嘌呤 (Hypoxanthine)
8. 以下哪种酶负责催化 dCTP 到 dUTP 的转化 (Which of the following enzyme catalyzes the conversion of dCTP to dUTP): ()
A. dCTP 氧化酶 (dCTP oxidase)
B. dCTP 还原酶 (dCTP reductase)
C. dCTP 甲基化酶 (dCTP methyltransferase)
D. dCTP 脱氨酶 (dCTP deaminase)
9. 真核生物核小体是由几个组蛋白分子组成的 (How many molecules of histone compose one eukaryotic nucleosome) ()
A. 5
B. 6
C. 7
D. 8
10. 以下哪种组分不是 PCR 反应所需的 (Which of the following component is NOT required in a PCR reaction): ()
A. 模版 (Template)
B. 引物 (Primer)
C. DNA 聚合酶 (DNA polymerase)
D. dNMP
11. 碳水化合物完全氧化后的最终产物是 (The ultimate product of complete oxidation of carbohydrates is): ()
A. 二氧化碳 (Carbon dioxide)
B. 乙酰辅酶 A (Acetyl CoA)
C. 丙酮酸 (Pyruvate)
D. 乙酸 (Acetate)
12. 一个 β -氧化循环产生多少个 $FADH_2$ 和 $NADH$ (How many $FADH_2$ and $NADH$ are produced by one round of the β -oxidation pathway): ()
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- A. 各 1 个 (1 each)
 - B. 1 FADH₂ 和 2 NADH (1 FADH₂ and 2 NADH)
 - C. 各 2 个 (2 each)
 - D. 2 FADH₂ 和 1 NADH (2 FADH₂ and 1 NADH)
13. 以下哪个属于酮体 (Which of the following is a ketone body): ()
- A. 草酰乙酸 (Oxaloacetate)
 - B. 乙酰乙酸 (Acetoacetate)
 - C. 脂肪酸 (Fatty acid)
 - D. 氨基酸 (Amino acid)
14. 以下哪个不是细胞内降解蛋白质的途径之一 (Which one of the following is NOT a way for cellular degradation of protein): ()
- A. 溶酶体途径 (lysosome)
 - B. 自噬途径 (autophagy)
 - C. 泛素修饰途径 (ubiquitin-proteasome)
 - D. 胰蛋白酶水解途径 (Trypsin)
15. 以下哪种关于类固醇激素的描述是正确的 (Which statement correctly describes steroid hormones): ()
- A. 它们在细胞中的作用是通过膜蛋白介导的 (Their intracellular actions are mediated by integral membrane proteins)
 - B. 它们对细胞的作用需要水溶性细胞内的信号 (Their effects on cells require a water-soluble intracellular signal)
 - C. 它们的作用是通过结合水溶性受体蛋白来介导的 (Their effects are mediated by binding to a water-soluble receptor protein)
 - D. 它们是由氨基酸前体直接合成而来 (They are synthesized directly from amino acid precursors)
16. 密码子简并性导致 (The degeneracy of genetic code results in): ()
- A. tRNA 的种类多于密码子的种类 (More tRNAs than codons)
 - B. 密码子的种类多于氨基酸的种类 (More codons than amino acids)
 - C. 核酸的种类多于密码子的种类 (More nucleotides than codons)
 - D. 密码子和氨基酸的种类同样多 (The same number of codons and amino acids)
17. 下列关于 λ 噬菌体阻遏物哪一项是错误的 (Which one is NOT correct about lambda repressor): ()
- A. λ 噬菌体阻遏物的 DNA 结合形式是二聚体 (The DNA-binding form of the Lambda repressor is a dimer)
 - B. λ 噬菌体阻遏物使用亮氨酸拉链基序来结合 DNA (Lambda repressor uses a Leucine Zipper motif to bind DNA)
 - C. λ 噬菌体阻遏物的功能是维持溶原性 (The function of the lambda repressor is to maintain lysogeny)
 - D. 一个 λ 噬菌体阻遏物结合操纵基因后将增强下一个阻遏物结合相邻操纵基因的亲和力 (Lambda repressor binding to one operator increases the affinity for binding a second repressor dimer to the adjacent operator)
18. 下列哪些蛋白结构域最有可能识别并结合核小体上的乙酰化赖氨酸 (Which of the following
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- protein domains would be most likely to recognize and bind to acetylated lysine residues on nucleosomes) : ()
- A. 同源异形域 (Homeodomains)
 - B. 锌指结构域 (Zinc fingers)
 - C. 布罗膜结构域 (Bromodomains)
 - D. 克罗莫结构域 (Chromodomains)
19. “摆动碱基配对”会发生在下列哪一对密码子中 (‘Wobble base pairing’ will occur for which one of the following pairs codons) : ()
- A. AUG 和 UGG (AUG and UGG)
 - B. AAA 和 UUU (AAA and UUU)
 - C. GGA 和 GGC (GGA and GGC)
 - D. UAG 和 UGA (UAG and UGA)
20. 你在实验过程中发现了一个新的 DNA 结合蛋白。下列哪个技术最适合鉴定与这个蛋白结合的 DNA 序列 (You discover a novel DNA-binding protein. What would be the best technique to define the identity of the specific DNA sequence to which this protein can bind) : ()
- A. 酵母双杂交分析 (Yeast two-hybrid assay)
 - B. 染色质沉淀-高通量测序 (ChIP-Seq assay)
 - C. 报告基因分析 (Reporter gene assay)
 - D. 免疫沉淀 (Immuno-precipitation)

三、判断题，正确的题请填写“+”，错误的题请填写“-” (每小题 1 分，共 30 分)

1. 蛋白质的肽键是平面的，但二面角旋转至三个偏好的角度。The peptide bond in proteins is planar, but rotates to three preferred dihedral angles. ()
2. 室温下 (25°C)，胰凝乳蛋白酶可以使蛋白水解速率提高约 $\sim 10^{10}$ 。这相当于将水解反应的活化能降低 47 kJ/mol。At room temperature (25°C), the proteolysis rate enhancement by chymotrypsin ($\sim 10^{10}$ folds) corresponds to a reduction in activation energy of about 47 kJ/mol. ()
3. 生糖氨基酸可以降解成丙酮酸或柠檬酸循环的中间产物。A glucogenic amino acid is one which is degraded to pyruvate or citric acid cycle intermediates. ()
4. 在离子交换层析法中，蛋白质是根据它们的净电荷量和尺寸大小分离的。In ion-exchange chromatography, proteins are separated on the basis of their net charge and size. ()
5. 蛋白质中肽键通常是顺式，除非下一个氨基酸是脯氨酸。The peptide bond in proteins is usually cis unless proline is the next amino acid. ()
6. 血红素是中心含有一个 Fe^{3+} 的卟啉类有机分子。The heme is an organic molecule derived from porphyrin with an Fe^{3+} at the center. ()
7. 蛋白质折叠时，构象的熵变是不利于折叠的。Conformational entropy is unfavorable for protein folding. ()
8. 核酸对紫外线的最大吸收峰在波长 280 nm 附近。The wavelength at which nucleic acids absorb ultraviolet light maximally is 280 nm. ()
9. 人体内嘌呤分解代谢的最终产物是尿酸。In human, the final degradation product of purine is uric acid. ()
10. 负责编码蛋白质的 RNA 是 tRNA。tRNA is the RNA responsible for coding protein. ()
11. DNA 双螺旋主要存在 A 型、B 型和 C 型三种形式。The major forms of DNA double helix are A

- form, B form and C form. ()
12. 在原核生物中, 紫外线产生嘧啶二聚体的主要修复方式为重组修复。The major repair of UV-induced pyrimidine dimers is homologous recombination in prokaryotes. ()
 13. CCC 突变为 CCA 属于无义突变。The CCC to CCA mutation is a non-sense mutation. ()
 14. GTP 是合成辅酶 A 的前体之一。GTP is one of the precursors needed to synthesize co-enzyme A. ()
 15. 转录因子主要结合在转录终止子上并负责转录的终结。Transcription factors majorly bind to transcription terminating signals and are responsible for transcription termination. ()
 16. 维生素 C 是一种水溶性维生素。Vitamin C is one of the water-soluble vitamins. ()
 17. 正常生理条件下, 胰岛素可同时促进糖原、脂肪和蛋白质的生物合成。Under normal physiology condition, insulin can simultaneously stimulate glycogen, fatty acid and protein biosynthesis. ()
 18. 糖酵解主要发生在线粒体中。Glycolysis mainly occurs in mitochondria. ()
 19. 嘌呤的从头合成是从天冬氨酸开始的。De novo purine synthesis starts with a molecule of Aspartate. ()
 20. 磷酸戊糖途径的主要功能是为细胞提供能量。The main function of the pentose phosphate pathway is to supply energy. ()
 21. C4 植物同化 CO₂ 消耗的能量比 C3 植物多。Carbon assimilations in C4 plants consume more energy than in C3 plants. ()
 22. 脂肪酸与血浆中的白蛋白结合进行运输。Fatty acids are carried by albumin in blood for transportation. ()
 23. 哺乳动物摄入的蛋白质在消化后转变为游离氨基酸进入细胞内。Proteins ingested by mammals are digested into free amino acids before entering cells. ()
 24. cAMP 在乳糖操纵子中的作用是使代谢阻遏物 CRP 失活。The function of cAMP in regulation of the *lac* operon is to inactivate the repressor protein CRP. ()
 25. 核糖体从 mRNA 的 5' 端到 3' 端读取信息, 而合成蛋白链的顺序则是由氨基端到羧基端。Ribosomes read mRNA from the 5' to the 3' end and synthesize the nascent protein chain from the aminol to the carboxyl terminus. ()
 26. 双杂交实验可以用来检测蛋白与蛋白之间的互作。The Two-Hybrid assay is used for detecting protein-protein interaction. ()
 27. 在哺乳动物的 X 染色体失活过程中, *Xist* 的作用是它能够编码一个蛋白促进其中的一条 X 染色体异染色质化, 同时抑制另一条 X 染色体异染色质化。The specific role of *Xist* in mammalian X-inactivation is to encode a protein that triggers heterochromatin formation on one X and suppresses it on the other X. ()
 28. CRP 单分子由 cAMP 单分子激活后结合到乳糖操纵子的 *O1* 操纵基因。A single molecule of CRP is activated by a single molecule of cAMP and binds to the *lac O1* operator. ()
 29. 在原核生物中, 翻译起始于形成了由 30S 核糖体亚基、mRNA、起始因子和 fMet-tRNA_f 构成的 30S 起始复合物。Translation in prokaryotes begins by the formation of a 30S initiation complex between the 30S ribosomal subunit, mRNA, initiation factors and fMet-tRNA_f. ()
 30. TATA 框能够帮助形成 RNA 聚合酶 III 转录复合物。A "TATA box" is to facilitate assembly of the RNA polymerase III transcription complex. ()

四、简答题 (每小题 5 分, 共 20 分)

1. 试从氨基酸代谢紊乱角度分析苯丙酮尿症的发病原因。Please try to analyze the pathogenesis of phenylketonuria from the point of view of amino acid metabolic disorder.
2. 列出信号转导的基本受体类型。Please list the common classes of receptors involved in signal transduction.
3. 做分子克隆酶切连接时, 为什么往往要选择能产生粘性末端而非平端的限制性内切酶? Why do people always select sticky end-generating rather than blunt end-generating enzymes to perform restriction and then ligation for molecular cloning?
4. 简述介导基因沉默的 miRNA 在细胞内是如何产生的。Please describe how the gene silencing miRNA is generated in cell.

五、问答题 (每小题 15 分, 共 60 分)

1. ATP对于变构酶PFK-1的影响如图1所示。对于特定浓度的6-磷酸果糖, 磷酸果糖激酶PFK-1的活性随着 ATP浓度的提高而升高, 但到达某一点时, 随着ATP浓度的升高, PFK-1活性反而受到了抑制。The effect of ATP on the allosteric enzyme PFK-1 is shown in Figure 1. For a given concentration of fructose 6-phosphate, the PFK-1 activity increases with increasing concentrations of ATP, but a point is reached beyond which increasing the concentration of ATP inhibits the enzyme.

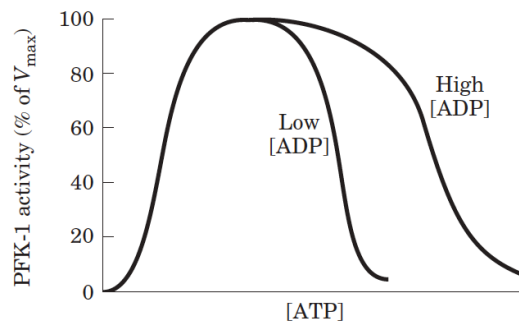


图1/Figure 1

- (a) 请解释为什么ATP既可以作为PFK-1的底物又能是其抑制剂? PFK-1是如何受ATP调控的? Explain how ATP can be both a substrate and an inhibitor of PFK-1. How is the enzyme regulated by ATP? (5分)
- (b) 整个糖酵解通路又是如何受ATP浓度影响的? In what ways is glycolysis regulated by ATP levels? (5分)
- (c) 如图1所示, 当ADP浓度高时, ATP对PFK-1的抑制就减弱了。如何解释这一现象? The inhibition of PFK-1 by ATP is diminished when the ADP concentration is high, as shown in Figure 1. How can this observation be explained? (5分)

2. 什么是表观遗传调控? 表观遗传调控的作用是什么? 在DNA水平、组蛋白和染色质水平分别有怎样的调控? What is the mechanism of epigenetic regulation? What is the function of epigenetic regulation? How will it be regulated at the DNA, histone and chromatin level?
3. 从mRNA翻译多肽链的过程, 遗传信息的保真度是如何保持的? How is the high fidelity of genetic information maintained in the translation process of a protein synthesis?
4. 原核生物和真核生物的DNA错配修复有哪些相同点和不同点? What are the similarities and differences in DNA mismatch repair pathways for prokaryotes and eukaryotes?