

清华大学本科生考试试题专用纸 (A)

考试课程 Biochemistry II 2007 年 1 月 14 日

考场纪律：

- 一、学生应试时必须携带学生证，以备查对，学生必须按照监考教师指定的座位就坐。
- 二、除答卷必须用的笔、橡皮及教师指定的考试用具外，不得携带任何书籍、笔记、草稿纸等。
- 三、答卷时不准互借文具（包括计算器）。题纸上如有字迹不清等问题，学生应举手请监考老师解决。
- 四、学生应独立答卷，严禁左顾右盼、交头接耳、抄袭或看别人答卷等各种形式的作弊行为，如有违反，当场取消其考试资格，答卷作废。
- 五、在规定的时间内答卷，不得拖延。交卷时间到，学生须在原座位安静地等候监考教师收卷后，方可离开考场。

系别_____ 班号_____ 学号_____ 姓名_____ 成绩_____

阅卷教师_____

题号	一	二	三	四	五	六	七	八	九	十	总分
成绩											

试题说明：

1. 选择题每题 1 分，答案可能是一个或多个，请将正确答案填在适当的横线处；
2. 问答题的分数标在题目后面，请将答案写在所提供的白纸上；
3. 本卷满分为 100。

I. Multiple choice questions:

1. The discontinuity of eukaryotic genes was first revealed by:
A. using footprinting techniques.
B. DNA sequence comparison.
C. RNA sequence analysis.
D. electron microscopic analysis of RNA-DNA hybrid molecules.
E. plant genetic studies.

Answer(s): D

2. The conversion of pyruvate to oxaloacetate is likely to require which of the following coenzyme?

- A. Biotin
- B. Vitamin B₁₂
- C. Thiamine pyrophosphate
- D. Flavin adenine dinucleotide
- E. Pyridoxal phosphate

Answer(s): A

3. Attenuation in the *trp* operon of *E. coli*:

- A. is a mechanism for increasing the transcription of the structural genes when Trp is

present in the growth medium

- B. serves to fine-tune the transcription of the operon in response to small changes in Trp availability
- C. results from the binding of the Trp repressor to the operator
- D. results from the presence of short leader peptides at the amino-terminal (5') end of each structural gene
- E. is a mechanism for inhibiting translation of existing (complete) trp mRNA

Answer(s): D

4. The entry point into the citric acid cycle for isoleucine, valine, and the product of odd-chain fatty acid is

- A. Fumarate
- B. Pyruvate
- C. Oxaloacetate
- D. Citrate
- E. Succinyl CoA

Answer(s): E

5. Which of the following events occurs during formation of phosphoenolpyruvate from pyruvate during gluconeogenesis?

- A. CO₂ is consumed
- B. Inorganic phosphate is consumed
- C. Acetyl CoA is utilized
- D. ATP is generated
- E. GTP is generated

Answer(s): A

6. In the classical model of transcriptional control described by Jacob and Monod, a repressor protein binds to

- A. an enhancer
- B. an UAG sequence
- C. an operator
- D. a ribosomal-binding site
- E. a TATA box

Answer(s): C

7. Some photosynthetic prokaryotes use H₂S, hydrogen sulfide, instead of water as their photosynthetic hydrogen donor. How does this change the ultimate products of photosynthesis?

- A. Carbohydrate (CH₂O) is not produced.
- B. H₂O is not produced.
- C. Oxygen is not produced.
- D. ATP is not produced.
- E. The products do not change.

Answer(s): C

8. What does it mean when the genetic code is described as “degenerate”?

- A. It means that the translation machinery is prone to making errors.
- B. It means that there are fewer codons than amino acids.
- C. It means that two or more anticodons can base pair with the same codon.

D. It means that more than one codon can specify the same amino acid.

Answer(s): D

9. Ames Test is used to investigate whether a chemical reagent is:

- A. oxidative.
- B. reductive.
- C. mutagenic.
- D. enzymatic.

Answer(s): C

10. Indicate which of the following events can occur during the processing of eukaryotic mRNA transcripts.

- A. Attachment of a poly (A) tail to the 5' end of the transcript.
- B. Methylation of all G residues.
- C. Excisions of introns.
- D. Conversion of standard bases to modified bases such as inosine.
- E. Splicing together of exons.

Answer(s): CE

11. You have discovered a compound that inhibits fumarase. How many moles of ATP would you expect to be generated from one mole of acetyl-CoA in the presence of this inhibitor?

- A. 5
- B. 6
- C. 6.5
- D. 7.5
- E. No ATP would form under these conditions.

Answer(s): D

12. Which of the following compounds **do not** directly provide atoms to form the purine ring?

- A. Aspartate.
- B. Carbamoyl phosphate.
- C. Glutamine.
- D. Glycine.
- E. CO₂.
- F. N⁵, N¹⁰-methylenetetrahydrofolate.
- G. N¹⁰-formyltetrahydrofolate.
- H. NH₄⁺.

Answer(s): BFH

13. Which of the following does not contribute to promoter binding by RNA polymerase in *E. coli*?

- A. rho factor
- B. -10 consensus sequence
- C. -35 consensus sequence
- D. β subunit of RNA polymerase
- E. β' subunit of RNA polymerase

Answer(s): A

14. An *E. coli* strain lacking DNA polymerase I would be deficient in DNA

- A. transcription
- B. methylation
- C. splicing
- D. degradation
- E. repair

Answer(s): E

15. Assuming the 5'→3' connection of writing nucleotide sequence, indicate which of the following mRNA codons can be recognized by the tRNA anticodon ICG.

- A. UGC
- B. CGA
- C. UGA
- D. CGU
- E. CGC

Answer(s): BDE

16. Which of the following is **true** about the difference between translation in prokaryotes and eukaryotes?

- A. Only prokaryotes have an initiation factor that binds the 5' cap structure on mRNAs.
- B. A Shine-Dalgarno sequence is needed for initiation of translation of only eukaryotic mRNAs.
- C. Translation and transcription are coupled only in prokaryotes.
- D. Only eukaryotic proteins initiate with a residue of N-formylmethionine.

Answer(s): C

17. Consider the mRNA sequence: (5') AAUGCAGCUUUAGCA (3'). The sequence of the coding strand of DNA is:

- A. (5') ACGATTTTCGACGTAA (3')
- B. (3') TTACGTCGAAATCGT (5')
- C. (5') AATGCAGCTTTAGCA (3')
- D. (5') AAUGCAGCUUUAGCA (3')
- E. (3') AATGCAGCTTTAGCA (5')

Answer(s): C

18. The synthesis of palmitate requires:

- A. 8 acetyl-CoA.
- B. 14 NADH.
- C. 7 ATP.
- D. 8 ATP
- E. 16 NADH.

Answer(s): AC

19. The enzyme(s) responsible for the transcription of eukaryotic rRNA is:

- A. RNA polymerase I
- B. RNA polymerase II
- C. RNA polymerase III
- D. RNA polymerase I and III
- E. RNA polymerase II and III

Answer(s): D

20. All of the following processes occur in the mitochondria of mammalian cells **EXCEPT**?

- A. fatty acid biosynthesis
- B. protein synthesis
- C. DNA synthesis
- D. β -oxidation of fatty acids
- E. the citric acid cycle

Answer(s): ABC

21. Which one of the following tissues can metabolize glucose, fatty acid and ketone bodies for ATP production?

- A. Liver
- B. Muscle
- C. Hepatocytes
- D. Brain
- E. Red blood cells

Answer(s): B

22. If the $\Delta G'$ of the reaction $A \longrightarrow B$ is -12 kJ/mol , which of the following statements is **correct**? (Note the prime symbol means that a thermodynamic parameter is measured at pH 7.0)

- A. The reaction will proceed spontaneously from left to right at the given conditions.
- B. The reaction will proceed spontaneously from right to left at standard conditions.
- C. The equilibrium constant favors the formation of A over the formation of B.
- D. The equilibrium constant could be calculated if the initial concentrations of A and B were known.
- E. The value of $\Delta G'^{\circ}$ is also negative.

Answer(s): A

23. Which of the following occurs in the degradation pathway of AMP?

- A. Adenine is converted to hypoxanthine.
- B. The end product is urea.
- C. AMP is converted to adenosine.
- D. Adenosine is converted to adenine.

Answer(s): C

24. Which pair correctly matches the enzyme with its allosteric activator?

- A. hexokinase; ATP
- B. phosphofructokinase-1; AMP
- C. pyruvate kinase; ATP
- D. pyruvate dehydrogenase; NADH
- E. pyruvate carboxylase; ADP

Answer(s): B

25. 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

Answer(s): B

26. List the steps of fatty acid synthesis in their correct order.

- A. The double bond is reduced to form butyryl-ACP.
- B. Condensation of the acetyl and malonyl groups produces an acetoacetyl group bound to ACP.
- C. The elements of water are removed to yield a double bond.
- D. The carbonyl group of acetoacetyl-ACP is reduced.
- E. The fatty acid synthase complex is charged with the correct acyl groups.

Answer(s): EBDCA

27. Common lesions found in DNA after exposure to ultraviolet light are

- A. transpositions
- B. single-strand breaks
- C. base deletions
- D. purine dimers
- E. pyrimidine dimer

Answer(s): E

28. Which of the following is a characteristic of many aminotransferase reactions?

- A. They have a large, negative ΔG° .
- B. The amino group is transferred to an α -keto acid (such as α -ketoglutarate) to form the corresponding amino acid.
- C. The amino group is transferred from an ammonia molecule.
- D. They are catalyzed by the same enzyme.
- E. They require the cofactor *S*-adenosylmethionine.

Answer(s): B

29. Which of the following compounds serves as a primary link between the citric acid and the urea cycle?

- A. Malate
- B. Succinate
- C. Isocitrate
- D. Citrate
- E. Fumarate

Answer(s): E

30. Indicate which of the following statements about the mitochondrial electron transfer and oxidative phosphorylation are **true**.

- A. Synthesized ATP must be transported into the intermembrane space before it can enter the cytosol.
- B. Cytochrome c and the F_1 subunit of ATPase are peripheral membrane proteins.
- C. Complexes I, II, III and IV are all proton pumps.
- D. Ubiquinone is a hydrophilic molecule.
- E. The final electron acceptor is H_2O .

Answer(s): AB

31. Which of the following is/are **true** of glycogen metabolism?

- A. Cyclic AMP-activated protein kinase stimulates glycogen synthase.
- B. Phosphorylase kinase is activated by phosphorylation.
- C. Phosphorylase b is inactivated by phosphorylation.
- D. Cyclic AMP levels are lowered by epinephrine and glucagon stimulation of adenylate cyclase.
- E. Glycogen synthesis is stimulated by glucagon.

Answer(s): B

32. Which of the following would describe fatty acid transport into the mitochondrial matrix?

- A. It is not the rate-limiting step in fatty acid oxidation.
- B. It is regulated by malonyl-CoA.
- C. The cytosolic and matrix pools of CoA are distinct and separate.
- D. Once fatty acyl groups have entered the matrix, they are committed to oxidation to acetyl-CoA.

Answer(s): BCD

33. Which of the following answers complete the sentence correctly? Surplus dietary amino acids may be converted into

- A. proteins.
- B. fats.
- C. ketone bodies.
- D. glucose.
- E. a variety of biomolecules for which they are precursors.

Answer(s): ABCDE

34. Which of the following is **not** used in the synthesis of fatty acid?

- A. Cobalamin (vitamin B₁₂)
- B. NADPH
- C. AMP
- D. FADH₂
- E. HCO₃⁻

Answer(s): ACD

35. Methylation of GATC sequences at _____ is believed to control the replication frequencies in *E. coli* cells.

- A. *oriC*
- B. *TER*
- C. The leading strand
- D. The lagging strand

Answer(s): A

36. Antimycin A blocks electron transfer between cytochromes *b* and *c*₁. If intact mitochondria were incubated with antimycin A, excess NADH, and an adequate supply of O₂, which of the following would be found in the oxidized state?

- A. Coenzyme Q
- B. Cytochrome *a*₃
- C. Cytochrome *b*

D. Cytochrome *e*

E. Cytochrome *f*

Answer(s): B

37. Carbon fixation involves a condensation reaction between CO₂ and:

A. 3-phosphoglycerate.

B. phosphoglycolate.

C. ribulose 1, 5-bisphosphate.

D. fructose 6-phosphate.

E. ribose 5-phosphate.

Answer(s): C

38. The oxidation of 3 mol of glucose by the pentose phosphate pathway may result in the production of:

A. 2 mol of pentose, 4 mol of NADPH, and 8 mol of CO₂.

B. 3 mol of pentose, 4 mol of NADPH, and 3 mol of CO₂.

C. 3 mol of pentose, 6 mol of NADPH, and 3 mol of CO₂.

D. 4 mol of pentose, 3 mol of NADPH, and 3 mol of CO₂.

E. 4 mol of pentose, 6 mol of NADPH, and 6 mol of CO₂.

Answer(s): C

39. Purine nucleotide biosynthesis can be inhibited by which of the following?

A. GTP

B. UMP

C. AMP

D. ATP

E. IDP

Answer(s): C

40. Prokaryotic and eukaryotic promoters:

A. contain AT-rich regions.

B. interact with transcription factors.

C. are influenced by base sequences thousands of base pairs away, which increase their activity.

D. are recognized by three different types of RNA polymerases, depending on location in the genome and type of transcript.

E. have all of the above properties.

Answer(s): A

41. Which of the following apolipoproteins is synthesized in the liver as part of the coat of very-low-density lipoproteins (VLDLs)?

A. B-48

B. E

C. A-I

D. B-100

E. C-II

Answer(s): BDE

42. Insulin has many direct effects on various cell types from such tissues as muscle, fat, liver, and skin. Which of the following cellular activities is decreased following exposure

to physiological concentrations of insulin?

- A. Plasma membrane transfer of glucose
- B. Glucose oxidation
- C. Gluconeogenesis
- D. Lipogenesis
- E. Formation of ATP, DNA, and RNA

Answer(s): C

43. Which of the following statements correctly describes metabolism?

- A. Fatty acids can be precursors of glucose.
- B. High energy levels turn on glycolysis.
- C. Synthesis and degradation of a substance do not occur at the same time.
- D. Phosphorylation activates enzymes that store fat and glycogen.
- E. Guanosine triphosphate (GTP) is the major donor for enzyme phosphorylation.

Answer(s): C

44. The reactions of the urea cycle occur

- A. In the cytosol
- B. In the mitochondrial matrix
- C. In the mitochondrial matrix and the cytosol
- D. In the lysosomes
- E. In peroxisomes

Answer(s): C

45. During fatty acid metabolism in humans, coenzyme A (CoA) is different from acyl carrier protein (ACP) in which one of the following ways?

- A. Binding of malonic acid with a phosphopantetheine
- B. Binding of fatty acids
- C. Function in fatty acid oxidation
- D. Function in the cytosol
- E. Function in fatty acid synthesis

Answer(s): C

46. Which one of the following contributes nitrogen to both purine and pyrimidine rings?

- A. Aspartate
- B. Carbamoyl phosphate
- C. Carbon dioxide
- D. Glutamine
- E. Tetrahydrofolate

Answer(s): AD

47. If a completely radioactive double-stranded DNA molecule undergoes two rounds of replication in a solution free of radioactive label, what is the radioactivity status of the resulting four double-stranded DNA molecules?

- A. Half should contain no radioactivity
- B. All should contain radioactivity
- C. Half should contain radioactivity in both strands
- D. One should contain radioactivity in both strands
- E. None should contain no radioactivity

Answer(s): A

48. Guanosine triphosphate (GTP) is required by which of the following steps in protein synthesis?

- A. Aminoacyl-tRNA synthetase activation of amino acids
- B. Attachment of ribosomes to endoplasmic reticulum
- C. Translocation of tRNA-nascent protein complex from A to P sites
- D. Attachment of mRNA to ribosomes
- E. Attachment of signal recognition protein to ribosomes

Answer(s): C

49. Which of the following statements correctly describes ketone bodies?

- A. They accumulate in the children with fatty acid oxidation disorders.
- B. They accumulate in diabetes mellitus after insulin therapy
- C. They are produced by muscle but not liver
- D. They include β -hydrobutyrate and acetone
- E. They are found in blood but not in urine

Answer(s): D

50. Citrate has a positive allosteric effect on which of the following enzymes?

- A. Pyruvate kinase
- B. Acetyl CoA carboxylase
- C. Phosphofructokinase
- D. Fatty acid synthetase
- E. Enolase

Answer(s): B

II. Short-answer questions:

1. Please explain why gluconeogenesis does not occur in muscle or brain cells.

(2 points)

没有 glucose 6-phosphatase

2. Please describe the major functions of DNA polymerase I, DNA polymerase III, helicase and DNA gyrase in the process of bacterial DNA replication. **(10 points)**

3. When you are running a 100 m race, you will consume more O_2 than when you walking slowly during the same time period. After finishing the race, you will continue to breathe at an elevated but declining rate for some minutes.

(a). Why do the O_2 needs increase dramatically during the sprint? **(3 points)**

(b). Why do the O_2 demands remain high after the sprint has been completed? **(3 points)**

4. Draw a simple map of the *lac* operon indicating the relative positions of promoter, operator, CRP-binding site, repressor gene (I), and the structural genes of the operon (A, Y Z). Indicate where the CRP protein binds within the operon. When it is bound to this site, does the CRP protein have a positive or negative effect on gene expression in this system? **(10 points)**

III. Comprehensive questions:

1. Explain **fully** the regulatory role of fructose 2,6-bisphosphate in gluconeogenesis and glycolysis, and the mechanism by which it affects fructose 1,6-bisphosphatase-1 and phosphofructokinase-1. How is the concentration of fructose 2,6-bisphosphate regulated? **(12 points)**
2. What is so called “coupled transcription and translation”? Using this term to distinguish the major difference between prokaryotic and eukaryotic gene expression system. You should be aware to include every possible and detailed difference around the question cited above. **(10 points)**

