

國立成功大學

111學年度碩士班招生考試試題

編 號： 56

系 所： 生命科學系

科 目： 生物化學及分子生物學

日 期： 0220

節 次： 第 3 節

備 註： 不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Part I: (Total 35 points)

1. Please briefly explain the following terms.
(2 points) (A) Abzymes
(2 points) (B) Ribozymes
(2 points) (C) Kinase
(2 points) (D) Low-Barrier Hydrogen Bonds
2. Since phosphorylation of Ser14 activates glycogen phosphorylase, we are going to use site-directed mutagenesis to manipulate the activity of glycogen phosphorylase.
(2 points) (A) Which amino acid should we use to replace Ser14 for constitutive inhibition of glycogen phosphorylase?
(2 points) (B) Which amino acid should we use to replace Ser14 for constitutive activation of glycogen phosphorylase?
3. (4 points) What is the secondary active transport and how does it work for transporting molecules?
4. (4 points) What are the differences between competitive inhibitors and pure noncompetitive inhibitors for enzyme inhibition?
5. (4 points) Please give two kinds of covalent modifications that regulate the activity of enzymes and also indicate the amino acid side chains for these covalent modifications.
6. (4 points) Please describe the essential features and the energetic consequences of glycolysis.
7. (4 points) Please describe the essential features and the energetic consequences of tricarboxylic acid (TCA) cycle.
8. (3 points) Please describe how to generate ATP from the electron transport pathway in the mitochondria.

Part II: (Total 25 points)

A. Multiple choice questions

9. (2 points) Which of the following is a palindromic sequence?

- A) AGGTCC
TCCAGG
- B) CCTTCC
GCAAGG
- C) GAATCC
CTTAGG
- D) GGATCC
CCTAGG
- E) GTATCC
CATAGG

10. (2 points) The function of the eukaryotic DNA replication factor PCNA (proliferating cell nuclear antigen) is similar to that of the β -subunit of bacterial DNA polymerase III in that it:

- A) facilitates replication of telomeres.
- B) forms a circular sliding clamp to increase the processivity of replication.
- C) has a 3' \rightarrow 5' proofreading activity.
- D) increases the speed but not the processivity of the replication complex.
- E) participates in DNA repair.

11. (2 points) In homologous recombination in *E. coli*, the protein that moves along a double-stranded DNA, unwinding the strands ahead of it and degrading them, is:

- A) *chi*.
- B) DNA ligase.
- C) RecA protein.
- D) RecBCD enzyme.
- E) RuvC protein (resolvase).

12. (2 points) The fundamental repeating unit of organization in a eukaryotic chromosome is:

- A) the centrosome.
- B) the lysosome.
- C) the microsome.
- D) the nucleosome.
- E) the polysome.

13. (2 points) Topoisomerases can:

- A) change the linking number (L) of a DNA molecule.
- B) change the number of base pairs in a DNA molecule.
- C) change the number of nucleotides in a DNA molecule.
- D) convert D isomers of nucleotides to L isomers.
- E) interconvert DNA and RNA.

14. (2 points) Based on Chargaff's rules, which of the following are possible base compositions for double-stranded DNA?
- | | %A | %G | %C | %T | %U |
|----|--------------------|----|----|----|----|
| A) | 5 | 45 | 45 | 5 | 0 |
| B) | 20 | 20 | 20 | 20 | 20 |
| C) | 35 | 15 | 35 | 15 | 0 |
| D) | All of the above. | | | | |
| E) | None of the above. | | | | |
15. (2 points) In the Watson-Crick model of DNA structure:
- A) both strands run in the same direction, 3' → 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 Å.
16. (2 points) 30S rRNA is a designation of the ____ of the RNA molecule.
- A) number of sugars
 - B) sedimentation coefficient
 - C) splicing coefficient
 - D) sequence repeats
 - E) splicing number
17. (2 points) AZT (3'-azido-2',3'-dideoxythymidine) is a drug that gets incorporated into growing viral DNA and blocks the activity of:
- A) DNA ligase.
 - B) DNA polymerase β (beta).
 - C) DNA polymerase α (alpha).
 - D) reverse transcriptase.
 - E) none of the above.
18. (2 points) In Sanger's method of DNA sequencing, what nucleotides were invented for the method.
- A) Dideoxynucleotide
 - B) Nucleotide
 - C) Deoxynucleotide
 - D) 5-fluorouridine
 - E) 2-aminopurine

B、

Short answer question

19. (5 points) What are two major pathways to repair DNA double-strand breaks?

Part III: (Total 40 points)

20. (4 points) Define operon and polycistronic mRNA.

21. *E. coli* cells are placed in a growth medium containing lactose. Indicate how the following circumstances would affect the expression of the lactose operon (increase/decrease/no change).

(1 point) (A) Addition of high levels of glucose

(1 point) (B) A *lac* repressor mutation that prevents dissociation of a *lac* repressor from the operator

(1 point) (C) A mutation that prevents binding of CRP to its binding site near the *lac* promoter

22. (6 points) The recognition of an amino acid by its cognate aminoacyl-tRNA synthetase is said to involve a "second genetic code." What is meant by this?

23. (4 points) In protein synthesis, 61 codons specify the 20 amino acids. Base pairing between the codon and the tRNA anticodon assures that the correct amino acid will be inserted into the nascent polypeptide chain. Why, then, does the cell require only 32 different tRNAs to recognize 61 different codons?

24. (6 points) A given mRNA sequence might be translated in any of three reading frames. Describe how prokaryotes and eukaryotes determine the correct reading frame.

25. (5 points) Describe the sequence of events between the transcription of an mRNA for a secreted protein and the arrival of that protein in the lumen of the endoplasmic reticulum.

26. (4 points) Describe the role of ubiquitin in mediating intracellular protein breakdown

27. (8 points/ 1 point each) The synthesis of fatty acids and their breakdown by β -oxidation occur by separate pathways. Compare the two paths by filling in the blanks below. (Some blanks may require more than one answer.)

	Synthesis	β -oxidation
Activating group	_____	_____
Electron carrier coenzyme(s)	_____	_____
Basic units added or removed	_____	_____
Cellular location of process	_____	_____