

國立成功大學  
111學年度碩士班招生考試試題

編 號： 61

系 所： 生物科技與產業科學系

科 目： 分子生物學

日 期： 0220

節 次： 第 2 節

備 註： 不可使用計算機

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※ 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。

一、選擇題 (單選): (72 分; 共 24 題, 每題 3 分)

1. DNA polymerase ensures that the correct nucleotide is incorporated into the growing strand of DNA by \_\_\_\_\_.
  - (a) detecting the identity of the incoming nucleotide specifically binding only the correct nucleotide in the active site
  - (b) selecting the correct nucleotide in an exonuclease active site in the DNA polymerase
  - (c) monitoring the ability of the incoming nucleotide
  - (d) to form either an A:T or G:C base pair
  - (e) to form either A:C or T:G base pair
  
2. Why would the absence of DNA primers in PCR cause the reaction to fail?
  - (a) The reaction lacks template DNA when primers are absent.
  - (b) The reaction lacks a primer:template junction, and thus a free 3'-hydroxyl group, when primers are absent.
  - (c) The reaction lacks a free 2'-hydroxyl when primers are absent.
  - (d) The reaction lacks single-stranded DNA when primers are absent.
  - (e) The reaction lacks a free 3'-hydroxyl when primers are absent.
  
3. Which one of the following factors significantly contributes to the ability of eukaryotic cells to complete DNA replication during the short window of time offered by S phase?
  - (a) The next round of replication begins before the cell exits S phase
  - (b) Eukaryotic DNA polymerases have dramatically increased processivity compared to DNA polymerases in organisms with smaller genomes
  - (c) Multiple origins of replication are activated per chromosome
  - (d) Origins of replication can initiate again after they have been replicated and before mitosis
  - (e) Initiate several runs of DNA replication
  
4. Dam methylase plays a role in mismatch repair in *E. coli*. Which of the following statements is true if Dam methylase is absent?
  - (a) There would be no effect on mismatch repair.
  - (b) The newly synthesized daughter strand containing the incorrect base and the parental strand will both be unmethylated and, therefore, either strand can serve as the template strand for mismatch repair.
  - (c) All DNA would remain methylated and therefore either strand can serve as the template strand for mismatch repair.
  - (d) Only the parent strand would be methylated and, therefore, only the parental strand can serve as the template strand for mismatch repair.
  - (e) None of above

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第2頁，共5頁

5. Translesion DNA synthesis accomplishes which of the following?
- (a) repairs DNA mutations
  - (b) removes damaged DNA
  - (c) allows DNA replication to proceed around DNA lesions that stall the replication fork
  - (d) stalls the replication fork
  - (e) None of above
6. Methylation and subsequent deamination of cytosine produces what type of mutation after one round of DNA replication?
- (a) C-to-T transversion
  - (b) C-to-T transition
  - (c) G-to-A transition
  - (d) C-to-A transversion
  - (e) C-to-G transversion
7. Eukaryotic RNA polymerase II synthesizes:
- (a) 5S rRNA
  - (b) 28S rRNA
  - (c) mRNA
  - (d) 18S rRNA
  - (e) tRNAs
8. Which of the following enzymes are homologs and have the same function?
- (a) RecA of *E. coli*; Spo11 of eukaryotes
  - (b) RecBCD of *E. coli*; MRX of eukaryotes
  - (c) RuvAB in *E. coli*; MRX of eukaryotes
  - (d) RuvC in *E. coli*; Spo11 in eukaryotes
  - (e) RecA of *E. coli*; Rad51 and Dmc1 of eukaryote
9. Which of the following statements about transposon target-site duplications is **NOT** true?
- (a) They are the recognition sequences for transposases.
  - (b) They result from the transposase-mediated strand transfer reaction.
  - (c) They are organized as direct repeats in all classes of transposable elements.
  - (d) The length of the duplicated sequence reveals the distance between the sites attacked and cut on each strand in the target DNA
  - (e) None of above
10. Which type of transposition is believed to be responsible for creating processed pseudogenes in vertebrate organisms?
- (a) LINE-promoted transposition

- (b) SINE-promoted transposition
- (c) cut-and-paste DNA transposition
- (d) V(D)J recombination
- (e) None of above

11. Various observations suggest that V(D)J recombination, which is an essential process for the maintenance of the vertebrate immune system, was evolutionarily derived from DNA transpositional recombination. Which of the following comparisons between V(D)J and DNA transpositional recombination is NOT true?

- (a) The V(D)J recombinase protein RAG1 is likely homologous with DDE transposases.
- (b) V(D)J recombination is similar to the replicative transpositional mechanism.
- (c) Recombination signal sequences are functionally similar to terminal inverted repeats.
- (d) Excision of genes in V(D)J involves the formation of a DNA-hairpin intermediate similar to that seen in the Hermes transposon pathway.
- (e) None of above

12. During transfer of T-DNA to a plant cell, what is transferred?

- (a) The original double-stranded T-DNA, displaced by synthesis of a new double-stranded copy
- (b) A newly synthesized double-stranded copy of the original T-DNA
- (c) The entire Ti plasmid, and all but the T-DNA is degraded
- (d) A single pre-existing DNA strand displaced by the synthesis of a new strand
- (e) A newly synthesized single strand

13. Which base is the most commonly methylated one in DNA?

- (a) adenine (b) cytosine (c) guanine (d) thymine (e) uracil

14. Which of the following descriptions of X-inactivation in mammals is true?

- (a) occurs early in embryonic development
- (b) only parental X chromosome is inactivated
- (c) only maternal X chromosome is inactivated
- (d) it is a reversible process
- (e) it is clonally propagated through meiosis

15. What is the role of the amino acid tryptophan in the Trp operon of *E. coli*?

- (a) an attenuator
- (b) an operator
- (c) an inactive repressor
- (d) a corepressor

(e) a positive effector

16. Histone protein modification regulates the gene expression in eukaryotes. Which modification is associated to the transcription activation?

- (a) H3K9me3
- (b) H3K14ac
- (c) H3K27me3
- (d) H3K36me3
- (e) H4K20me2

17. Which technique is **NOT** used for gene knockdown of eukaryotic cells?

- (a) double-stranded RNA (dsRNA) injection
- (b) microRNA (miRNA) injection
- (c) complementary RNA (cRNA) injection
- (d) small interfering RNA (siRNA) injection
- (e) short hairpin RNA (shRNA) injection

18. Where does mRNA splicing occur in animal cells?

- (a) nucleus
- (b) ER lumen
- (c) cytoplasm
- (d) Golgi apparatus
- (e) peroxisome

19. The chain, 5'-AUGGGACAA-3', represent three codons. If a single-base mutation occurs, which strand is the silent mutant?

- (a) 5'-AUGGGAUAA-3'
- (b) 5'-AUGGGACAC-3'
- (c) 5'-AUGGUACAA-3'
- (d) 5'-AUGUGACAA-3'
- (e) 5'-AUGGGUCA-3'

Codon table					
1st base	2nd base				3rd base
	U	C	A	G	
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic acid	Glycine	U
	Valine	Alanine	Aspartic acid	Glycine	C
	Valine	Alanine	Glutamic acid	Glycine	A
	Valine	Alanine	Glutamic acid	Glycine	G

20. During protein translation, ribosome translocation moves deacylated tRNA from \_\_\_\_\_

- (a) A site to P site
- (b) A site to E site
- (c) P site to E site
- (d) P site to A site
- (e) E site to P site

21. Which one is **NOT** the function of the mRNA Cap?

- (a) facilitates mRNA export out of the nucleus
- (b) protects the mRNA from degradation
- (c) assists initiation of translation
- (d) stimulates splicing of the first intron
- (e) promotes the mRNA release from RNA polymerase II

22. Which of the following is **NOT** the property of eukaryotic translation?

- (a) binding of rRNA to the Shine–Dalgarno sequence, which lies upstream from the AUG codon in the mRNA
- (b) binding of the small ribosomal subunit to the 5' cap of mRNA
- (c) the subunit migrates to the initiation site by scanning for AUG codons
- (d) when the small subunit recognizes an appropriate AUG initiation codon, it is joined by a 60S large subunit.
- (e) recognizing UAA, UAG, and UGA as the termination codons

23. During protein translation, which protein recognizes the codon UAA in *E. coli*?

- (a) IF-1 (b) IF-2 (c) EF-Tu (d) EF-G (e) RF1

24. Which technique is **NOT** used to monitor the gene expression level?

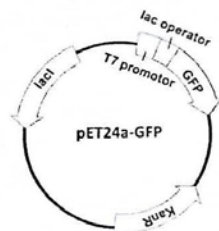
- (a) Co-immunoprecipitation (b) RNA-seq (c) RT-qPCR (d) Northern blotting (e) Microarray

二、簡答題：(28 分)

1. What types of genes are transcribed by RNA polymerase III? (4%) What types of promoters do these genes have? (4%)

2. What is the telomere problem in the DNA replication? (3%) What does the telomerase function? (3%)

3. This figure shows a DNA plasmid used to express GFP in *E. coli*. What is the function of *lacI*? (4%) Why does the addition of isopropylthiogalactoside (IPTG) can induce protein expression? Please explain the mechanism. (4%)



4. Coronaviruses are enveloped positive-sense single-stranded RNA viruses. How does the SARS-CoV-2 coronavirus complete its life cycle? (6%)