

# 國立嘉義大學九十三年學年度

## 生物科技研究所碩士班招生考試試題

### 科目：分子生物學

#### 一、選擇題：50% (單選題，每題 2 分)

- The chromosomal region that is the point of attachment of the mitotic spindle is the:
  - Alu sequence.
  - telomere.
  - centromere.
  - intron.
  - exon.
- Which of these statements about nucleic acids is false?
  - The genome of many plant viruses is RNA.
  - The chromosome of *E. coli* is a closed-circular, double-helical DNA.
  - Mitochondria and chloroplasts contain DNA.
  - The DNA of viruses is commonly many times longer, in its extended form, than the virus itself.
  - Plasmids are genes that encode plasma proteins in mammals.
- An Okazaki fragment is a:
  - small segment of DNA that is an intermediate in the synthesis of the lagging strand.
  - fragment of RNA that is a subunit of the 30S ribosome.
  - segment of mRNA synthesized by RNA polymerase.
  - piece of DNA that is synthesized in the 3' → 5' direction.
  - fragment of DNA resulting from endonuclease action.
- "Footprinting" or DNase protection is a technique used to identify:
  - E. coli* cells that contain a desired, cloned piece of DNA.
  - the position of a particular gene of a chromosome.
  - the specific binding site of a repressor, polymerase, or other protein on the DNA.
  - the position of internally double-stranded regions in a single-stranded DNA molecule.
- Compared with DNA polymerase, reverse transcriptase:
  - makes fewer errors in synthesizing a complementary polynucleotide.
  - makes more errors because it lacks the 3' → 5' proofreading exonuclease activity.
  - introduces no errors into genetic material because it synthesizes RNA, not DNA.
  - synthesizes complementary strands in the opposite direction--from 3' → 5'.
  - has none of the above characteristics.
- In bacteria the elongation stage of protein synthesis does not involve:
  - GTP.
  - peptidyl transferase.
  - EF-Tu.
  - IF-2.
  - aminoacyl-tRNAs.
- Consider the lac operon of *E. coli*. When there is neither glucose nor lactose in the growth medium:
  - repressor is bound to the lac operator.
  - RNA polymerase binds lac promoter and transcribes the lac operon.
  - CRP protein binds to the lac operator.
  - CRP protein displaces the Lac repressor from the lac promoter.
  - None of the above are true.
- Which of the following eukaryotic regulatory proteins interact with enhancers?
  - basal transcription factors
  - transactivators
  - coactivators
  - repressors
  - TATA-binding proteins
- Protein synthesis can occur while the mRNA molecules is being synthesized in:
  - Prokaryotes only.
  - Eukaryotes only.
  - Unicellular organisms only.
  - Multicellular organisms only.
  - All organisms can do this.
- Which ends of prokaryotic mRNA are protected from degradation?
  - 5' end only.
  - 3' end only.
  - Both ends.
  - Neither end.
  - The RNA is circular and has no ends.
- Which of the following statements concerning introns is not correct?
  - They are frequently present in eukaryotic genes but rarely in prokaryotic genes.
  - They are transcribed but not translated.
  - They contain base sequences that code for unusual amino acid sequences in proteins.
  - There can be multiple introns within a single gene.
- Functional DNA is not found in:
  - chloroplasts.
  - mitochondria.
  - nuclei.
  - lysosomes.
  - bacterial nucleoids.
- The proofreading function of DNA polymerase involves all of the following except:
  - reversal of the polymerization reaction.
  - a 3' → 5' exonuclease.
  - base pairing.
  - phosphodiester bond hydrolysis.
  - detection of mismatched base pairs.

14. Which of the following statements about *E. coli* RNA polymerase is false?
- The holoenzyme has several subunits.
  - The enzyme cannot synthesize RNA in the absence of DNA.
  - The core enzyme alone binds to specific DNA regions, but cannot initiate synthesis without a sigma factor.
  - The enzyme adds nucleotides to the 3' end of the growing RNA chain.
  - The RNA produced by this enzyme will be completely complementary to the DNA template.
15. A single base change in an mRNA may result in:
- no change in the protein.
  - a change in the amino acid sequence of the protein.
  - a shortening of the protein.
  - all of the above.
  - none of the above.
16. The signal sequences that direct proteins to the nucleus are:
- always at the amino terminus of the targeted protein.
  - cleaved after the protein arrives in the nucleus.
  - not located at the ends of the peptide, but in its interior.
  - glycosyl moieties containing mannose 6-phosphate residues.
  - the same as those that direct certain proteins to lysosomes.
17. Which of the following is a DNA sequence?
- enhancer.
  - transactivator.
  - coactivator.
  - All of the above are DNA sequences.
  - None of the above is a DNA sequence.
18. Which of the following is not involved in steroid hormone action?
- cell surface receptors
  - transcription activation and repression
  - specific DNA sequences
  - zinc fingers
  - All of the above are involved.
19. The sigma ( $\sigma$ ) subunit has all the following properties, except:
- It tells the RNA polymerase where to sit down.
  - It helps point the RNA polymerase in the proper direction.
  - It causes the RNA polymerase to bind tightly to the DNA.
  - It stays with the RNA polymerase throughout synthesis.
  - All of these describe the sigma factor.
20. The protein which marks proteins for degradation is called:
- Chaperonin.
  - Ubiquitin.
  - Proteasomin.
  - Apoptosin.
  - None of these names is correct.
21. The DNA in a bacterial (prokaryotic) chromosome is best described as:
- a single linear double-helical molecule.
  - multiple linear double-helical molecules.
  - a single circular double-helical molecule.
  - a single linear single-stranded molecule.
  - multiple linear single-stranded molecules.
22. When a DNA molecule is described as replicating bidirectionally, that means that it has two:
- origins.
  - chains.
  - replication forks.
  - independently replicating segments.
  - termination points.
23. Which of the following statements is true?
- Exonucleases degrade DNA at a free end.
  - Endonucleases degrade circular but not linear DNA molecules.
  - Many DNA polymerases have a proofreading 5'  $\rightarrow$  3' exonuclease.
  - E. coli* DNA polymerase I is unusual in that it possesses only a 5'  $\rightarrow$  3' exonucleolytic activity.
24. Reverse transcriptase:
- is encoded by retroviruses.
  - can utilize only RNA templates.
  - has a 3'  $\rightarrow$  5' proofreading exonuclease but not a 5'  $\rightarrow$  3' exonuclease.
  - synthesizes DNA with the same fidelity as a typical DNA polymerase.
  - is activated by AZT.
25. The enzyme that attaches an amino acid to a tRNA (aminoacyl-tRNA synthetase):
- always recognizes only one specific tRNA.
  - catalyzes formation of an ester bond.
  - attaches a specific amino acid to any available tRNA species.
  - attaches the amino acid at the 5' end of the tRNA.
  - splits ATP to ADP + P<sub>i</sub>.
- 二、簡答題：10%
- Mutation on gene coding sequence may result in the production of either wild-type or mutant proteins. These mutations can be categorized into “nonsense mutations”, “missense mutations”, “neutral mutations”, “silent mutations, and “frameshift mutations”. Briefly describe the mutation effects, resulted from each mutation type, on the protein sequence. ( 5% )
  - Please briefly describe the following terms: ( 5% )
    - $\rho$ -independent transcription termination.
    - Attenuator in trp-operon.
    - Enhancer.
- 三、申論題：40%
- In both prokaryotes and eukaryotes, most (if not all) gene expressions are controlled through protein-DNA interactions via certain transcription factors or activators. Filter binding assay, gel mobility shift assay, and DNA footprinting are among the most common methodologies applied in protein-DNA interaction studies. Please described these methods. ( 20% )
  - 為究明某種重要性狀(例如植物抗病基因)的分子機制,分子遺傳學家通常必須先進行遺傳研究,即誘變及篩選該重要性狀發生改變的突變體。然而在實際誘變工作中,經常不易獲得預期中的突變體。試解釋之。( 20% )