

國立高雄大學 109 學年度研究所碩士班招生考試試題

科目：分子生物學

系所：生命科學系

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

I. 單選題 (每題 2 分；共 50 分)【務必將答案依序填寫於答案卷上印製的選擇題答案欄內！】

1. During standard electrophoresis, to which pole would one expect the following macromolecules to migrate: *RNA, DNA, protein*?
 - A. positive pole, positive pole, either pole depending on charge, respectively
 - B. negative pole, positive pole, either pole depending on charge, respectively
 - C. negative pole, negative pole, either pole depending on charge, respectively
 - D. positive pole, negative pole, positive pole, respectively
 - E. none of the above
2. The biological role of restriction enzymes is to:
 - A. aid recombinant DNA research.
 - B. degrade foreign DNA that enters a bacterium.
 - C. make bacteria resistant to antibiotics.
 - D. restrict the damage to DNA by ultraviolet light.
 - E. restrict the size of DNA in certain bacteria.
3. The *E. coli* recombinant plasmid pBR322 has been widely utilized in genetic engineering experiments. pBR322 has all of the following features *except*:
 - A. a number of conveniently located recognition sites for restriction enzymes.
 - B. a number of palindromic sequences near the *EcoRI* site, which permit the plasmid to assume a conformation that protects newly inserted DNA from nuclease degradation.
 - C. a replication origin, which permits it to replicate autonomously.
 - D. resistance to two different antibiotics, which permits rapid screening for recombinant plasmids containing foreign DNA.
 - E. small overall size, which facilitates entry of the plasmid into host cells.
4. Which of the following statements regarding plasmid cloning vectors is correct?
 - A. Circular plasmids do not require an origin of replication to be propagated in *E. coli*.
 - B. Foreign DNA fragments up to 45,000 base pairs can be cloned in a typical plasmid.
 - C. The copy number of plasmids may vary from a few to several hundred.
 - D. Plasmids do not need to contain genes that confer resistance to antibiotics.
 - E. Plasmid vectors must carry promoters for inserted gene fragments.
5. When considering the nature of genetic regulation in eukaryotes, one often comes across the term "**housekeeping genes**". We could expect that such housekeeping genes would
 - A. provide mRNAs which are not protected at their 5' and/or 3' ends
 - B. be active only in heart and liver cells because they are the most vital cells in an organism
 - C. code for proteins which are essential for all cells of an organism
 - D. provide hnRNAs which do not undergo intron removal
 - E. code for proteins which are found only in certain cell types
6. Although the expression of most genes is tightly regulated, some genes are expressed at roughly constant rates (*i.e.* constitutively). Which of the following genes would you predict to be constitutively expressed?
 - A. Genes involved in the biosynthesis of tryptophan (an amino acid)
 - B. Genes involved in the degradation of tryptophan
 - C. Genes involved in the degradation of arabinose, a sugar
 - D. Genes that code for ribosomal RNAs
 - E. Genes involved in the transport of maltose, a sugar, into the cell

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7. The relationship between DNA fragment size and mobility in an agarose gel is best described as a(n)
 - A. linear relationship between size and mobility.
 - B. no significant relationship between size and mobility.
 - C. only dependent on the concentration of agarose in the gel.
 - D. independent of the voltage and current conditions used during electrophoresis.
 - E. approximately logarithmic relationship between size and mobility.
8. The Sanger or dideoxy method of nucleotide sequence determination
 - A. relies on sequence-specific termination of an enzymatically synthesized DNA chain.
 - B. requires some knowledge about the nucleotide sequence of the region to be characterized.
 - C. is much less common than the Maxam-Gilbert method of sequence analysis.
 - D. is inherently complicated by the requirement for a binding site for a sequencing primer.
 - E. is based on preferential, base-specific methylation
9. Which of the following methods can be used to detect the gene activity?
 - A. primer extension
 - B. Northern blot
 - C. Southern blot
 - D. Western blot
 - E. DNase footprinting
10. Which of the following is most likely to lead to a loss-of-function of a gene?
 - A. A change from T to C in the promoter region
 - B. A missense mutation in the open reading frame
 - C. A frameshift mutation in the coding region
 - D. A sequence change in the 3' untranslated region
 - E. A change from a TAA codon to a TAG codon in the coding region
11. An *E. coli* cloning vector would usually contain all of the following EXCEPT:
 - A. an *E. coli ori*
 - B. a MCS for insertion of the gene of interest
 - C. a *bla* gene that confers ampicillin resistance on the host
 - D. a telomere sequence so that it is recognized as a chromosome
 - E. a *lacZ* gene that's used for blue/white color selection
12. The target sequence used in PCR is:
 - A. the sequence the Taq polymerase recognizes in order to bind
 - B. synthesized artificially and added to the PCR reaction
 - C. the sequence the primer recognizes in order to bind
 - D. the DNA molecule that contains a small region to be amplified
 - E. the sequence that will be amplified
13. In the Southern blotting procedure
 - A. Labeled probe DNA is used to visualize target DNA bound to a membrane
 - B. DNA polymerase synthesizes DNA while bound to a membrane
 - C. Bands of radioactively labeled DNA are separated by gel electrophoresis
 - D. Single strand binding protein (SSB) is used to bind single stranded DNA to a membrane
 - E. RNA primers are used to make many copies of DNA that is transferred to a membrane
14. Gene regulation in both prokaryotes and eukaryotes is achieved by controlling which process?
 - A. Translation
 - B. transcription
 - C. histone coiling
 - D. cellular differentiation
 - E. RNA splicing
15. The standard Watson-Crick model of DNA favored at high relative humidity and in solution is
 - A. Z-DNA
 - B. A-DNA
 - C. B-DNA
 - D. C-DNA
 - E. T-DNA

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16. Restriction enzymes are found in virtually all bacterial species, and their sequence specificities cover almost all possible short (4-6 bp) sequences. Why do you think this is the case?
- A. Restriction enzymes were put on Earth by a kindly God to make the lives of molecular biologists easier
 - B. Restriction enzymes provide the means by which bacteria carry out gene cloning
 - C. Restriction enzymes provide protection for the cell against invasion of foreign DNA
 - D. Restriction enzymes provide a means to ensure that the cells' DNA is properly and specifically methylated
 - E. Restriction enzymes recognize as foreign any DNA that contains copies of their recognition sequence and destroy it
17. What are the functions of ammonium persulfate (APS), TEMED and SDS used in polyacrylamide gel electrophoresis?
- A. catalyst, initiator, dye B. catalyst, initiator, change the protein charge
 - C. initiator, catalyst, break the disulfide bond D. initiator, catalyst, change the protein charge
 - E. catalyst, initiator, break the disulfide bond
18. Which of the following does *not* apply to the construction or use of a DNA library?
- A. Specialized DNA libraries can be made by cloning DNA copies of mRNAs.
 - B. Determining the location of a particular DNA sequence in a DNA library requires a suitable hybridization probe.
 - C. The DNA copies of mRNA found in a cDNA library are made by reverse transcriptase.
 - D. Many segments of DNA from a cellular genome are cloned.
 - E. Genomic libraries are better for expressing gene products than cDNA libraries.
19. Which of the following characteristics are the principles of separation of proteins in denaturing condition during two-dimensional (2-D) gel electrophoresis experiment?
- | <u>First dimension</u> | <u>Second dimension</u> |
|-----------------------------|--------------------------|
| A. Hydrophobicity | Subunit molecular weight |
| B. Density | Charge |
| C. Subunit molecular weight | Density |
| D. amino acid composition | Charge |
| E. isoelectronic point (pI) | Subunit molecular weight |
20. The ribosome is involved in all of the following except
- A. aminoacylation of tRNA B. binding of aminoacyl tRNA to mRNA
 - C. peptide bond formation D. binding of mRNA at an initiation codon
 - E. binding of protein factors during elongation
21. The newly synthesized DNA with addition of nucleotides moving in the same direction as the replication fork is
- A. template strand B. lagging strand C. leading strand
 - D. Okazaki fragment E. RNA primer
22. Assume that you were given a vial containing 0.05 μ g/ μ l of DNA and you are asked to set up a reaction which calls for 100ng of DNA. What volume of fluid from the vial would you deliver?
- A. 20 ml
 - B. 200 μ l
 - C. 2 ml
 - D. 2 μ l

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- E. 20 μ l
23. A certain bacterial mRNA is known to represent only one gene and to contain about 800 nucleotides. If you assume that the average amino acid residue contributes 110 to the peptide molecular weight, the largest polypeptide that this mRNA could code for would have a molecular weight of about:
- A. 800.
 - B. 5000.
 - C. 30,000.
 - D. 80,000.
 - E. An upper limit cannot be determined from the data given.
24. A messenger ribonucleic acid is 336 nucleotides long, including the initiator and termination codons. The number of amino acids in the protein translated from this mRNA is:
- A. 999
 - B. 333
 - C. 110
 - D. 111
 - E. 112
25. Assuming that the average amino acid residue contributes 110 to the peptide molecular weight, what will be the minimum length of the mRNA encoding a protein of molecular weight 50,000?
- A. 5,000 nucleotides
 - B. 1,400 nucleotides
 - C. 460 nucleotides
 - D. 133 nucleotides
 - E. A minimum length cannot be determined from the data given

II. 問答題 (每題 10 分；共 50 分)

1. 何謂 central dogma? 說明之
2. 說明 post-transcriptional 的調控為何?
3. 何謂 operon? 說明之
4. 何謂 CRISPR? 其應用為何?
5. 比較 DNA 及 RNA 的結構差異?