

國立中山大學生物科學系 98 學年上學期
博士班資格考試(筆試)

分子生物學 2009 資格考

姓名

學號

單選題: 每題 1 分, 共 32 分

1. Which of the following is not a constituent of deoxyribonucleotides?
 - a. phosphate moieties
 - b. deoxyribose
 - c. ribose
 - d. organic bases
2. Which base pair(s) typically occur(s) in double-stranded DNA?
 - a. G·C
 - b. G·T
 - c. G·A
 - d. G·G
3. Which of the following terms is not used to describe a parameter of DNA topology?
 - a. wobble
 - b. writhe
 - c. twist
 - d. linking number
4. Which structural property of DNA is crucial for the conservation of genetic information?
 - a. antiparallelism
 - b. the ability to form a double helix
 - c. base-pair complementarity
 - d. all of the above
5. The ability of DNA to denature is important for which process?
 - a. DNA synthesis
 - b. nucleic acid hybridization experiments
 - c. RNA synthesis
 - d. all of the above
6. Which of the following are removed from mRNAs during processing?
 - a. exons
 - b. noncoding sequences
 - c. RNA cap structure
 - d. poly(A) tail
7. The base in the wobble position of a codon
 - a. is the 5' (first) base.
 - b. is the 3' (third) base.
 - c. is the second base.
 - d. often contains adenine.
8. RNA composes all or part of
 - a. termination factors.
 - b. small nuclear ribonucleoproteins.
 - c. DNA polymerase.
 - d. ribozymes.
9. In eukaryotic cells, protein synthesis in the cytoplasm utilizes three types of RNA molecules. Which of the following contains a three nucleotide sequence called the anticodon?
 - a. mRNA
 - b. tRNA
 - c. rRNA
 - d. all of the above

10. Which of the following is not a recognized stage of protein synthesis in both prokaryotes and eukaryotes?
- elongation
 - initiation
 - translation
 - termination
11. Which of the following factors recognizes the UAG, UAA, and UGA codons?
- RNA polymerase
 - DNA polymerase
 - termination factors
 - elongation factors
12. Which codon serves as the start codon in mRNA for translation?
- AGU
 - AUG
 - UGA
 - UGG
13. Which of the following is a protein that is involved in translation?
- topoisomerase
 - ribosomal RNA
 - RNA polymerase
 - aminoacyl-tRNA synthetase
14. Which of the following structures interacts with ribosomes?
- tRNA
 - mRNA
 - rRNA
 - all of the above
15. Cellular protein synthesis proceeds in which direction?
- carboxyl to amino terminus
 - amino to carboxyl terminus
 - 3' to 5'
 - 5' to 3'
16. Which nucleic acid structure has its bases methylated after synthesis?
- DNA
 - mRNA
 - tRNA
 - rRNA
17. In which of these polymers are the monomers added one at a time?
- DNA
 - rRNA
 - protein
 - all of the above
18. Which of the following is not required for both DNA replication and RNA transcription?
- DNA
 - primers
 - RNA
 - proteins
19. An enzyme that breaks DNA, dispels the tension, and reseals the strand ahead of a DNA replication growing fork is called a(n)
- topoisomerase.
 - DNA polymerase.
 - phosphodiesterase.

d. aminoacyl-tRNA synthetase.

20. Which of the following enzymes plays a key role in the base excision repair of nucleotide mismatches and damaged bases?

- a. glycosamines
- b. glycosidases
- c. glycosylases
- d. none of the above

21. A mutation that changes a cysteine codon to a tryptophan codon is called

- a. a missense mutation.
- b. a nonsense mutation.
- c. a frameshift mutation.
- d. a silent mutation.

22. Crossing of a homozygous wild type with a mutant that is heterozygous for a dominant mutation will result in F₁ progeny of which

- a. all show the mutant phenotype.
- b. half show the wild-type phenotype and half show the mutant phenotype.
- c. three-fourths show the wild-type phenotype and one-fourth show the mutant phenotype.
- d. all show the wild-type phenotype.

23. A mutation in one gene that counteracts the effects of a mutation in another gene is known as a

- a. temperature-sensitive mutation.
- b. recessive mutation.
- c. conditional mutation.
- d. suppressor mutation.

24. Which of the following enzymes will produce a blunt end (the cut site is indicated by the * in the recognition sequence)?

- a. *TaqI* (T*CGA)
- b. *EagI* (C*GGCCG)
- c. *EcoRV* (GAT*ATC)
- d. *NsiI* (ATGCA*T)

25. DNA ligase

- a. synthesizes DNA from an RNA template.
- b. forms a phosphodiester bond.
- c. joins Okazaki fragments.
- d. b and c
- e. all of the above

26. Which of the following is a functional element of a plasmid?

- a. origin of replication
- b. drug-resistance gene
- c. polylinker sequence
- d. a and b
- e. all of the above

27. All the following statements about λ phage are true except:

- a. λ phage lyse *E. coli* upon release of newly synthesized phage.
- b. Foreign DNA up to approximately 50 kilobases can be cloned into λ phage.
- c. Both cDNA and genomic DNA can be cloned into λ phage.
- d. λ Phage consists of a head and tail region.

28. A DNA sequencing reaction contains which of the following?

- a. dideoxyribonucleoside triphosphates
- b. deoxyribonucleoside triphosphates

- c. DNA polymerase
- d. b and c
- e. all of the above

29. The polymerase chain reaction (PCR) technique can be used for

- a. direct isolation of a specific segment of genomic DNA.
- b. preparation of probes.
- c. synthesis of RNA from genomic DNA.
- d. a and b
- e. all of the above

30. In the large-scale production of a particular human protein in *E. coli* cells, the cDNA corresponding to the protein was modified so that the expressed protein would have six histidine residues at the C-terminus. The purpose of this modification was

- a. to facilitate transfer of the cDNA into the *E. coli* cells.
- b. to provide a promoter for the transcription of the cDNA in *E. coli*.
- c. to facilitate purification of the expressed protein through binding to an affinity column containing chelated nickel atoms.
- d. to prevent degradation of the expressed protein by *E. coli* proteases.

31. A mutation that changes the recognition sequence for the restriction enzyme *EcoRI* from GAATTC to GATTTTC is an example of a

- a. restriction fragment length polymorphism (RFLP).
- b. single nucleotide polymorphism (SNP).
- c. simple sequence repeat (SSR).
- d. a and b
- e. all of the above

32. To study the function of the essential cytosolic *Hsc70* genes in yeast, researchers constructed a shuttle vector in which a copy of the *Hsc70* gene was ligated to the *GAL1* promoter. The vector was then introduced into haploid yeast cells in which all four copies of the *Hsc70* genes had been disrupted. Following introduction of the vector, you would expect that

- a. the yeast cells would grow on both glucose and galactose media.
- b. the yeast cells would grow on glucose but not galactose medium.
- c. the yeast cells would grow on galactose but not glucose medium.
- d. on transfer to either glucose or galactose medium, the vector-carrying cells would eventually stop growing because of insufficient *Hsc70* activity.

問答題:

1. Use *Drosophila* sex determination genes sex lethal (*sxl*), transformer (*tra*) and doublesex (*dsx*) as examples, explain how the fly exploits alternative mRNA splicing in regulating sex determination during embryo development. (18 分)
2. Describe in detail how prokaryotic RNA polymerase holoenzyme works in transcription, includes in your answer the domains or structures important or critical for each process of RNA transcription (20 分)
3. Some mRNAs has internal ribosome entry site, IRES that is important for translation initiation. Compare and contrast the mechanism of translation initiation directed by IRES-containing and conventional capped and polyadenylated mRNA. (15 分)
4. Describe the processes of DNA replication. Include in your answer the essential components and their functions in each process during DNA replication. (15 分)

國立中山大學生物科學系 98 學年上學期
博士班資格考試(筆試)

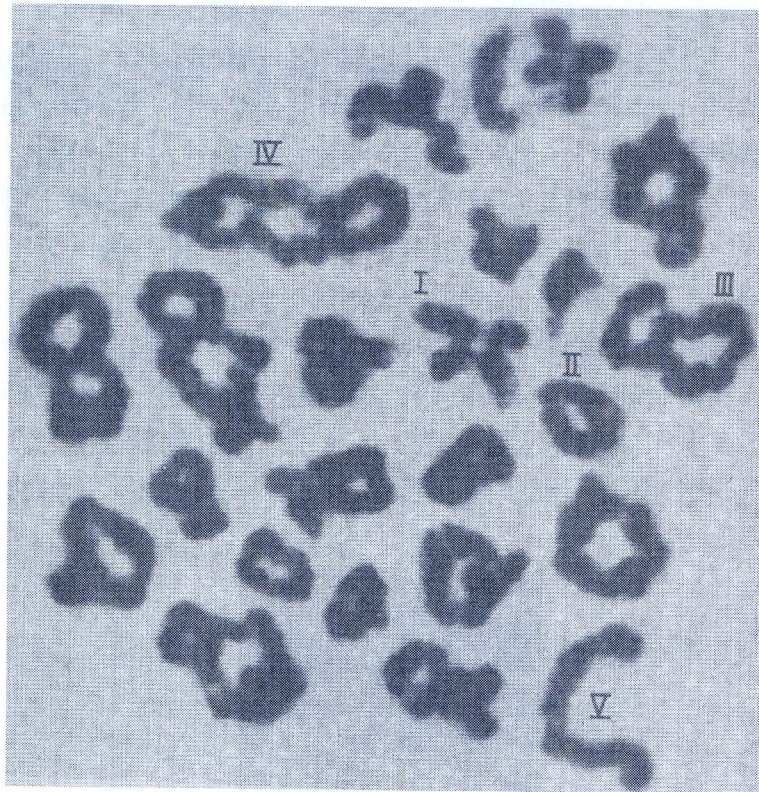
科目：細胞分子生物學

【考試所需時間：125 分鐘】
(請老師填寫)

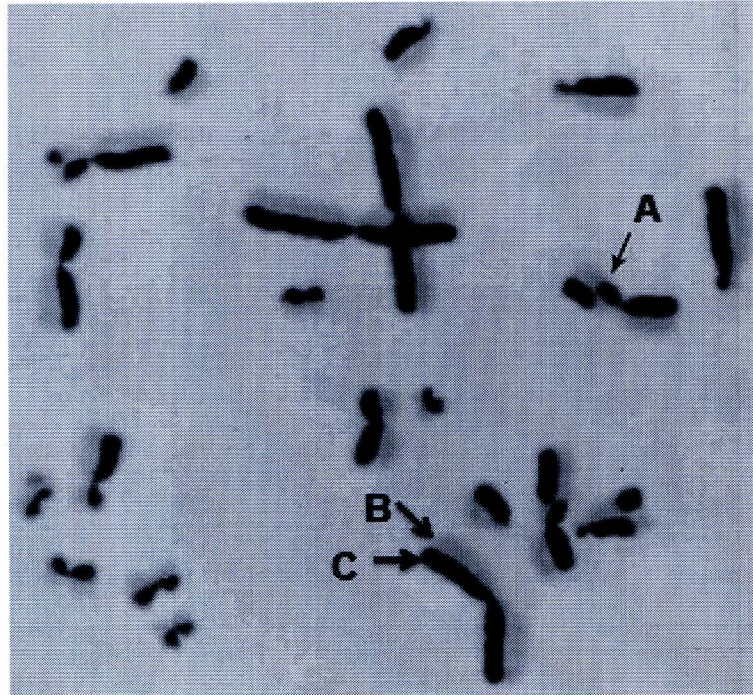
1. 以下的結果是經由幾個步驟而獲得的：(1) 首先從某細胞中純化出信使 RNA (mRNA)；(2) 經由反轉錄 (Reverse transcription) 獲得互補 DNA (即 cDNA)；(3) 比較 cDNA 序列與其基因體 DNA (genomic DNA) 的序列得到以下的最佳結果。請解釋這種現象，並說明其產生的過程。

Genomic DNA CCGT CCCGGA GG
cDNA AAACCGTAAAAAGGGCCTAAAACC

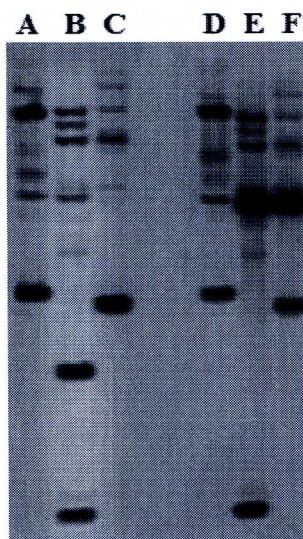
2. 下圖是正常人類精母細胞 (spermatocyte) 的染色體圖譜。請分別說明，用羅馬數字標示的 I、II、III、IV，及 V 等染色體的行為。



3. 下圖是小鼠骨髓細胞經過在含有 5-溴尿嘧啶 (5-bromouracil) 的培養液中培養兩個細胞周期 (two cell cycles) 後所製備的染色體圖譜。整張圖片說明了什麼？圖中 A、B 及 C 三個箭頭所指有何含義？



4. 初始 B 淋巴細胞 (Naïve B cell) 經過抗原的再一次刺激後，一部份轉為漿細胞 (plasma cell)，另一部份仍保留記憶細胞 (memory cell) 的功能。現從漿細胞中提取到信使 RNA (mRNA)，轉成互補 DNA (cDNA) 後發現，cDNA 種類的數量不足一般細胞的 1/10。每一個漿細胞的基因體 DNA (Genomic DNA) 的總量也不足一般細胞的 1/10。請解釋這一分子機制。
5. 下列是利用同一分子探針與不同來源的信使 RNA 進行分子雜交所得的結果。每一個泳道 (lane) 均為一種生物早期發育細胞中所提取的信使 RNA，經電泳分離後轉移至硝酸纖維膜 (Nitrocellulose membrane) 上，再與同一探針雜交後進行放射自顯影的結果。A 及 C 為蚯蚓及線蟲；B 及 E 為果蠅及蝗蟲；D 及 F 為真菌及阿拉伯芥。試分析下列結果並說明其生物學意義。



國立中山大學生物科學系 98 學年上學期
博士班資格考試(筆試)

科目：生態學

【考試所需時間：3 小時】
(請老師填寫)

25 points each.

1. How to measure biodiversity?
2. Describe and discuss various kinds of life history classifications.
3. Discuss the biological community successional mechanisms.
4. Describe and discuss the relationship between area and species number.

國立中山大學生物科學系 98 學年上學期
博士班資格考試(筆試)

科目：行為生態學

【考試所需時間：100分鐘】
(請老師填寫)

Qualify Examination

Behavioral Ecology

1. What is game theory? Describe the behavioral strategies in the Hawk-Dove game and discuss it with the concept of evolutionary stable strategy. (18 points)
2. Give an example to demonstrate that animals defend a territory with an optimal size? How can this size be estimated? (12 points)
3. Describe the handicap and Fisher's hypotheses related to the elaborate male sexual displays. (12 points)
4. Give examples on sexual conflict and describe them in details.(12 points)
5. Explain the hypotheses which have been proposed for the reason(s) of males aggregating into leks. (12 points)
6. How signals originate and how they are modified during evolution? (12 points)
7. Why are most birds monogamous whereas most mammals polygynous? (12 points)
8. What are the topics often appear in the text books on behavioral ecology? (10 points)

國立中山大學生物科學系 98 學年上學期
博士班資格考試(筆試)

科目：演化生物學

【考試所需時間：

4 h

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(請老師填寫)

中山生科系博士班資格考 2009 演化生物學試題

請利用圖來對比下列成對的關鍵詞

說明：

- A. 以能明確區分兩個對比詞為答題目標，文字以註記圖為限，整句文字部份不計分
- B. 優先考慮以有 X-Y 軸之圖來表達，且須明確註明 X,Y 軸各自為何
- C. 關書考，4 小時為限，若監考人同意，可延長
- D. 自選 10 題最有把握的回答，可用鉛筆，以利塗改，超過 10 題部份不評分

Directional selection vs disruptive selection

Founder effect vs bottleneck effect

Gene flow vs genetic drift

Microevolution vs macroevolution

Autopolyploidy vs allopolyploidy

Positive selection vs negative selection

Sibling species vs sister species

Synonymous vs nonsynonymous substitution

Stasis vs gradualism

Dispersal vs vicariance hypotheses

Allopatric vs sympatric speciation

Convergence vs common ancestry

Monophyletic vs paraphyletic groups

Underdominance vs overdominance

Blending vs particulate inheritance

Orthologous genes vs paralogous genes

Density-dependent vs density-independent population growth

Frequency-dependent selection vs frequency-independent selection

(不敷使用，請用 A4 紙書寫)