國立中興大學

110 學年度
碩士班考試入學招生

試　題

學系：基因體暨

　　　生物資訊學研究所

科目名稱：生物化學

第一部分 (33 分)

I. 單選題: (30 分)

1. In addition to their ability to polymerize nucleotides, most DNA polymerases also can function as
A. 5'-to-3' exonucleases.
B. ligases.
C. topoisomerases.
D. 3'-to-5' exonucleases.
E. primases.

2. Unwinding the double helix to separate the parental strands requires a
A. primase.
B. DNA ligase.
C. DNA polymerase.
D. topoisomerase.
E. helicase.

3. In the Holliday model of homologous recombination, two nicked duplexes come together to form regions which can be substrates for mismatch repair and gene conversion, and are known as
A. replication forks.
B. heteroduplexes.
C. primosomes.
D. Okazaki fragments.

4. The histone molecules
A. represent the special type of topoisomerase enzymes.
B. are associated only with the chromocenter in polytene nuclei.
C. are negatively charged.
D. are highly conserved.

5. Which of the following is found only in prokaryotes?
A. aminoacyl tRNA synthetase
B. promoter sequences
C. polycistronic mRNA
D. leader sequences
E. all of the above

6. Which of the following features is common to both DNA replication and transcription?
A. nucleotides are added to the 5' end of the newly synthesized strand.
B. a sugar-phosphate bond is formed between the 3' hydroxyl and the 5' phosphate.
C. deoxyribonucleotides are incorporated into the growing sequence.
D. both RNA and DNA polymerases require oligonucleotide priming.

7. All of the following may result from promoter mutations, except
A. decreased affinity for RNA polymerase.
B. increased affinity for RNA polymerase.
C. mutant RNA polymerase.
D. unregulated transcription.
E. a new phenotype.

8. Which of the following is characteristic of prokaryotic mRNA?
A. polyadenlyation of the 3' end.
B. a short half-life.
C. removal of introns to form mature message.
D. formation of lariat structures.
E. capping of the 5' terminus.

9. (T to A) or (G to T) mutations are
A. transition mutations.
B. transversion mutations.
C. translation mutations.
D. transcription mutations.
E. conditional mutations.

10. The C-value paradox refers to
A. the differences in the number of genes among different organisms.
B. high GC content in the genomes of some eukaryotes.
C. the lack of correlation between genome size and the level of metabolic, developmental, and behavioral complexity among eukaryotes.
D. the degree of condensation of the chromatin fibers within the nuclei of all eukaryotic cells.
E. the inability to determine the length of DNA fragments directly from the observed $C_0t_{1/2}$ values.

11. In eukaryotes, the enzyme responsible for transcribing all protein-coding genes is
A. RNA polymerase I.
B. RNA polymerase II.
C. RNA polymerase III.

12. What type of repair is said to be error prone?
A. excision repair
B. SOS repair
C. photoreactivation
D. mismatch repair
E. postreplication repair

13. In human beings the inherited autosomal recessive disease xeroderma pigmentosum is the result of a defect in
A. the system that repairs alkylated DNA.
B. the system that repairs ultraviolet light damaged DNA.
C. the system that repairs base deletions.
D. the mismatch repair system.
E. the SOS repair system.

14. Circular molecules of the same size migrate at different rates in electrophoretic gels depending on whether they are supercoiled or relaxed circles because
A. they are differently charged.
B. they have different conformations.
C. they have different GC content.
D. All of the above
E. None of the above

15. Intergenic suppression is
A. suppression of a mutant phenotype because of a second mutation in the same gene.
B. suppression of a mutation because of an exact reversal of the change that occurred in the original forward mutation.
C. a mutational change in a second independent gene that eliminates the mutant phenotype.
D. suppression of crossing-over between two genes or homologous chromosomes.

II. 簡答題: (3 分)
1. What is central dogma of molecular biology?

第二部分 (33 分)

I. 選擇題：(18 分)

1. 生物體中的巨分子生合成的過程中有校正(proofreading)的機制的是(1) DNA，(2) RNA，(3) protein，(4) polysaccharide。

2. 2018 年中國生物學家賀建奎披露其主導的全球首兩名基因編輯(CRISPR)嬰兒誕生，他針對 CCR5 進行編輯，以抵禦何種病毒入侵？(1) HBV，(2) HPV，(3) HIV，(4) COVID-19。

3. 下列何種突變技術精準度最高？(1) CRISPR，(2) 基因轉殖，(3) 放射線誘變，(4) 化學誘變。

4. 關於 Secondary active transport 二級主動運輸何者為真？(1) 濃度由高往低處運輸，(2) 消耗 ATP，(3) 產生膜電位差，(4)無須運輸蛋白參與。

5. 咖啡與茶葉因為含有咖啡因及茶鹼常被充為提神飲料，咖啡因及茶鹼主要的作用是何種物質的類似物？(1) ATPP，(2) ADP，(3) AMP，(4) cAMP。

6. DNA 為雙股螺旋結構，請問下列何者是維持 DNA 骨架的主要力量？(1) 氫鍵，(2) 共價鍵，(3) 凡德瓦爾力，(4) 疏水作用力。

7. DNA 為雙股螺旋結構，影響 DNA 熱穩定性的主要因素為：(1) 凡德瓦爾力，(2)氫鍵的方向性，(3)氫鍵的數目，(4) 含氮鹼基的大小。

8. 葉酸的主要功用是提供 UTP 甲基使其轉換成為 (1) ATP，(2) TTP，(3) GTP，(4) CTP。

9. 下列何者不是真核生物 mRNA 轉譯後修飾？(1) 剪切多餘的核酸，(2) 額外添加核酸序列，(3) 共價鍵修飾，(4)利用氫鍵形成二級結構。

II. 問答題：(15 分)

10. 若希望將 X 基因選殖到表現載體 pET-20b(+)中使其在轉殖到 *E. coli* 後可以表達出與 His-tag 融合的重組蛋白質，方便以鎳離子親和性管柱(nickel resin)進行純化，請問設計引子時應注意那些事項？(5 分)

11. PCR 為快速增幅 DNA 的技術，請問進行 PCR 反應時應加入哪些物質？(5 分)

12. 請說明選殖用的載體(cloning vector)與表現用的載體(expression vector)的異同。(5 分)

第三部分 (34 分)

I. 請說明改正以下敘述錯誤之處 (34 分，每題 2 分)

1. Methionine is the only amino acid that has a phosphorus atom in its side chain.

2. Trypsin and chymotrypsin have a catalytic triad of serine, histidine and aspartate within the active site. The side chain of the catalytic serine acts as either a proton donor or acceptor.

3. Arginines are important amino acid residues in hemoglobin. The prosthetic heme group binds to the proximal arginine residue, while the distal arginine residue stabilizes the O_2 molecule by hydrogen-bonding interactions.

4. In order for a virus like the COVID-19 virus to be detected early in the body using real time RT–PCR, scientists need to convert the viral protein to DNA. This is a process called 'reverse transcription'.

5. GTP serves two functions in muscle contraction: First, GTP releases actin from myosin, and second, GTP hydrolysis provides the energy required for muscle contraction.

6. Gel filtration is also known as size-exclusion chromatography. It separates proteins solely on the basis of the specific interaction between proteins and the column matrix.

7. One of the most important interactions to stabilize the DNA and RNA macromolecules is the charge interaction between pairs of nitrogenous bases.

8. A lipid bilayer is a biological membrane consisting of two layers of lipid molecules. Each lipid molecule contains a hydrophobic head and a hydrophilic tail.

9. Like other coronaviruses, the SARS-CoV-2 genome encodes spike (S) glycoproteins, which protrude from the surface of mature virions. Glycoproteins are proteins which contain glycines covalently attached to the protein surface.

10. The alpha helix (α-helix) is a common secondary structure of proteins. The interior of an α-helix is completely filled with atoms, because all the side chains insert into the helical interior.

11. Vitamin B12 (cyanocobalamin) is an essential cofactor for the two enzymes required for collagen synthesis: prolyl hydroxylase and lysyl hydroxylase.

12. A COVID-19 antibody test is a blood test that can tell if you previously had COVID-19 and have since recovered. These antibodies covalently bind to SARS-CoV-2 proteins.

13. Enzymes increase the activation energy necessary to transform a reactant into a product.

14. SDS-PAGE is a technique to separate or analyze proteins based on their molecular weight. During this process, lower molecular weight proteins move more slowly through the porous acrylamide gel than higher molecular weight proteins.

15. The formation of a disulfide bond between two cysteine residues in a protein requires a reducing agent, such as vitamin C.

16. The isoelectric point is the temperature at which a molecule carries no net electrical charge or is electrically neutral.

17. The Ramachandran plot shows the statistical distribution of the peptide bonds in terms of torsion angles.

國立中興大學

111 學年度

碩士班考試入學招生

試題

招生系所：基因體暨生物資訊學研究所

科目名稱：計算機概論

本科目不得使用計算機　　　　　　　　　　　　　　　本科目試題共 3 頁

Part I Single choice (60 points, 3 points for each)

1. Which is NOT the correct statement about algorithm?
   (A) Each problem has an algorithm to solve (B) Some problems have many algorithms to solve
   (C) Design an algorithm before programming (D) Evaluate an algorithm by time complexity

2. Which is NOT the correct statement about tree?
   (A) Tree is one kind of data structure (B) Tree can has cycle
   (C) Only one path exists in any two nodes (D) Tree do not be linked fully if remove any edge

3. Which data structure is adopted to the file and directory system in MS Windows
   (A) linked list (B) database (C) graph (D) tree

4. Which is the interpreting language?
   (A) BASIC (B) FORTRAN (C) PASCAL (D) JAVA

5. Which language is NOT portable?
   (A) assembly language (B) COBOL (C) C++ (D) JAVA

6. Which technology needs the Certificate Management Center support?
   (A) CRC verification (B) DES encryption (C) symmetric encryption (D) asymmetric encryption

7. Which layer does the http protocol belong to?
   (A) application (B) transmission (C) network (D) physical

8. How many different letter sequences can be obtained by rearranging the letters in the word EFFORT?
   (A) 1440 (B) 180 (C) 360 (D) 720

9. What is Git?
   (A) an operating system (B) a version control system (C) a programming language
   (D) a database management system

10. The IPv4 IP address space includes five classes: A, B, C, D, and E; which class does 140.120.1.20 belong to?
    (A) A (B) B (C) C (D) D

11. In order to solve the problem of insufficient IP addresses, how many bits does IPv6 use?
    (A) 64 (B) 128 (C) 256 (D) 512

12. What is BASH?
    (A) a Unix shell (B) a command language (C) a command line interpreter (D) all of the above are correct

13. What does the unsigned decimal value 183 look like in binary using 8 bits?
    (A) 01110101 (B) 10110111 (C) 11110101 (D) 11110011

14. Which type of memory can be read and changed in any order?
   (A) EPROM (B) EEPROM (C) PROM (D) RAM

15. According to the history of computer science development of the following instruments, a) integrated circuit, b) large integrated circuit, c) transistor, d) vacuum tube; which order is true?
   (A) dabc (B) dcba (C) dcab (D) abcd

16. If i = 3, j = 10, k = 8, which logical expression is true?
   (A) i + k <= j (B) (i < j) AND NOT (j > k)
   (C) ((i < k) OR (j > k)) AND (k >= 0) (D) NOT ((i > j) OR (k > i))

17. If the code is set as "LET A=2+3*2-2^2/2", what the A is?
   (A) 6 (B) 32 (C) 8 (D) 2

18. What is the output from the following C code?
```
int a = 5;
for (int i = 0; i < 20; i = i+1)
{
   i = i + a;
   printf("%d ",i);
}
```
   (A) 5 10 15 20 (B) 5 11 17 23 (C) 6 12 8 24 (D) 6 11 17 22

19. What is the output from the following C code?
```
int a = 2, b = 3;
int c = 4, d = 5;
int val;
val = b/a + c/b + d/b;
printf("%d ",val);
```
   (A) 3 (B) 4 (C) 5 (D) 6

20. It becomes common applications to use python for web scraping, for example, mask map, air pollution data, etc. When you see the following short web scraping code, which description is correct?
```
[
  {
     "title":"資訊安全",
     "author":"趙大師",
     "category":"Web",
     "pubdate":"06/2020",
     "id":"S101"
  },
  {
     "title":"PHP 網頁設計",
     "author":"趙大師",
     "category":"Web",
     "pubdate":"07/2020",
     "id":"P101"
  },
]
```
   (A) This code is a program of data exchange, and could be JSON format to achieve the exchange between python program and web data
   (B) If this is JSON format, we can import the json module using "import json" and decode the data using "books = json.loads(contents.decode('utf-8-sig'))" in the web scraping code
   (C) If we want to retrieve name and book number for each book, the following code can be used: "for book in books: print("書號: ", book["id"], end="-") print("書名: ", book["title"])"
   (D) All of the above are correct

Part II (40 points)

1. Neural Networks
(a) What are the components of neural networks? (5 points)
(b) Please explains how neural networks work? (10 points)

2. Internet of Things (IoT)
(a) What is IoT? (10 points)
(b) Please give an example of IoT applications. (5 points)

3. Pease design a C program to print out leap years between 2000-3000 (AD); how many leap years we will have? (10 points)
   P.S. conditions for leap years:
   a. years which are divisible by 400
   b. the other years which are divisible by 4, but not 100