國立中山大學104學年度碩士暨碩士專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】　　題號：421003

※本科目依簡章規定「不可以」使用計算機(混合題)　　

一、選擇題每題1分(25%) 單選

1. What word below refers to a pair of homologous chromosomes?
A) chromophores B) bivalent C) birefringence D) bilateral E) nucleolus

2. What was the first treatment to be shown to be mutagenic?
A) ultraviolet irradiation B) infrared irradiation C) X-rays D) microwaves E) radio waves

3. What is the name of chromosomes that have as many as 1024 times the number of DNA strands usually present?
A) polymorphic chromosomes B) polytene chromosomes C) homologous chromosomes
D) heterozygous chromosomes E) papillosomes

4. The building blocks of a nucleotide are _____.
A) a pentose sugar and a phosphate group
B) a pentose sugar and a nitrogenous base
C) a phosphate group and a nitrogenous base
D) a pentose sugar, a phosphate group and a nitrogenous base
E) a pentose sugar, a phosphate group and an amino acid

5. You isolate DNA from a particular organism and analyze it. The amount of adenine was 6 μmoles and the A+T/G+C ratio is 4.0. How much thymine would be found in the sample?
A) 6 μmoles B) 3 μmoles C) 1.5 μmoles D) 4 μmoles E) 12 μmoles

6. What gives a DNA molecule its negative charge?
A) deoxyribose B) ribose C) phosphate groups D) chlorine ion E) adenine

7. What is one explanation for the wide discrepancies in genome sizes from species to species?
A) More advanced organisms have more DNA.
B) Genomes have an extremely variable number of repeated DNA sequences that do not code for proteins.
C) Some organisms have multiple repeats of each gene.
D) More advanced organisms have more genes.
E) More advanced organisms have more centromeric DNA.

8. _____ is thought to be derived from a reverse transcriptase encoded by an ancient retrotransposon.
A) Phosphatase B) Esterase C) Telomerase D) Protein kinase E) Phosphodiesterase

9. Why has the One Gene – One Polypeptide hypothesis had to be modified?
A) It was totally wrong.
B) Genes can be spliced differently to generate a variety of related polypeptides.
C) Enzymes sometimes consist of more than one polypeptide, each of which is coded for by its own gene.
D) Enzymes actually code for genes.
E) Polypeptides code for genes.

10. The site on DNA to which RNA polymerases bind before initiating transcription is called the _____.
A) terminator B) operator C) promoter D) enhancer E) silencer

11. Which eukaryotic RNA polymerase synthesizes the larger rRNAs, like 28S, 18S and 5.8S rRNAs?
A) RNA polymerase I B) RNA polymerase II C) RNA polymerase III
D) RNA polymerase IV E) RNA polymerase V

12. What is responsible for synthesizing hnRNAs?
A) RNA polymerase I B) RNA polymerase II C) RNA polymerase III
D) reverse transcriptase E) general transcription factors

13. What molecule is TFIIH known to phosphorylate?
A) a G protein B) RNA polymerase II C) RNA polymerase IV
D) peptidyltransferase E) DNA helicase

14. The 3' end of most eukaryotic mRNAs contains a _____, while the 5' end has a _____.
A) poly(A) tail, methylated guanosine cap B) poly(U) tail, methylated guanosine cap
C) methylated guanosine cap, poly(A) tail D) poly(A) tail, sulfonated guanosine cap
E) methylated guanosine cap, poly(U) tail

15. The macromolecular complex that associates with each intron and splices it is called a(n) _____.
A) splicer B) acrosome C) spliceosome D) splicing body E) splice engine

16. Why is it thought that RNAi may have evolved to protect the cell from viral infection and replication and/or the movement of transposons within the genome?
A) Both processes involve RNA binding to DNAs.
B) Both involve RNA binding to specific cellular proteins.
C) Both processes typically involve the formation of double-stranded RNA intermediates.
D) Both processes typically involve the formation of double-stranded DNA intermediates.
E) Both processes typically involve the formation of single-stranded RNA intermediates.

17. What is the significance of the variability of the third nucleotide in a codon?
A) Each tRNA can recognize and bind its own codon.
B) Each tRNA can recognize and bind its own amino acid.
C) The same tRNA can recognize more than one codon.
D) The same tRNA can recognize more than one anticodon.
E) The same anticodon can recognize more than one amino acid.

18. After an amino acid is adenylated in the first step of the activation of a tRNA, where is the adenylated amino acid found?
A) bound to ATP B) bound to the aminoacyl-tRNA synthetase
C) bound to peptidyltransferase D) floating free in the nucleus
E) floating free in the cytoplasm

19. Peptide bond formation is accomplished as the amine nitrogen of the aa-tRNA in the _____ carries out a _____ of the amino acid bound to the _____.
A) A site, nucleophilic attack on the carbonyl carbon, tRNA of the P site
B) P site, nucleophilic attack on the carbonyl carbon, tRNA of the A site
C) A site, acidophilic attack on the carbonyl carbon, tRNA of the P site
D) A site, electrophilic attack on the carbonyl carbon, tRNA of the P site
E) P site, electrophilic attack on the carbonyl carbon, tRNA of the A site

20. The upstream activator sequences (UASs) of yeast are analogous to _____ in higher eukaryotes.
A) promoters B) TATA boxes C) operators D) enhancers

21. Because of the imprecision of molecular joining, recombination between LV and J regions shows considerable variation. This regulation is called DNA _____?
A) transmutation B) rearrangement C) modification D) conjugation E) transduction

22. A DNA microarray (also called a DNA chip) can be used to _____.
A) isolate genes from eukaryotic cell nuclei
B) assay protein output from a genomic database
C) mutate genes of interest
D) trap genes that are both active and inactive
E) scan a population of nucleic acids for abundance

23. *Proteomics* is the _____.
A) harvesting of proteins from a cell to determine their economic value
B) manipulation of amino acid sequences in proteins to alter their function
C) process of defining the complete set of proteins encoded by a genome
D) changing of the terminal sequences of proteins to alter their function
E) rational design of drugs based on protein structure

24. The sequences 5'-GTCACGACTAGCCATCAGCCTG-3' contain a six-nucleotide inverted repeat, it is _____?
A) GTCACG B) CACGAC C) CGACTA C) ACTAGC

25. Eukaryotic genomes have several features not found in prokaryotes, not including
A) Gene density B) Introns C) Repetitive sequences D) Promoters

二、選擇題每題1.5分(15%) 單選

26. When a gene has been duplicated one or more times, what are the possible things that can happen to the duplicated gene?
A) The duplicated gene can accumulate favorable mutations and acquire a new function.
B) The duplicated gene can be lost during evolution through deletion.
C) The duplicated gene can be rendered nonfunctional by unfavorable mutations.
D) If there are two copies of the gene, both could undergo mutation so that each evolves a more specialized function than the original gene.
E) All of these are correct.

27. A transposable element is a type of genetic parasite that can invade a host genome from the outside world, spread within the genome and be transmitted to offspring. Under what circumstances, would a transposable element not be able to accomplish this?
A) if it has serious adverse effects on the ability of the host to survive and reproduce
B) if it does not have serious adverse effects on the ability of the host to survive and reproduce
C) if it speeds up the activity of amylase
D) if is slows down the activity of triosephosphate isomerase
E) if it increases the rate at which an organism can sense time

28. Which of the following is not a normal property of eukaryotic mRNAs?
A) They contain a continuous nucleotide sequence encoding a specific polypeptide.
B) They are found in the cytoplasm and inside the Golgi complex.
C) They are attached to ribosomes when they are translated.
D) Most have a significant noncoding segment that does not direct assembly of amino acids.
E) Eukaryotic mRNAs have special modifications at their 5' and 3' termini.

29. Before the genetic code was actually known, Francis Crick predicted that it was degenerate. What piece of evidence led him to make this prediction?
A) All proteins looked the same.
B) All proteins were made of amino acids.
C) He noted that the base composition of the DNAs of various bacteria varied greatly while the amino acid composition of their proteins varied very little overall.
D) He noted that the base composition of the DNAs of various bacteria varied little while the amino acid composition of their proteins varied greatly overall.
E) The code was nonoverlapping.

30. Which of the following clusters of terms applies when addressing *enhancers* or *silencers* as elements associated with eukaryotic genetic regulation?
A) *cis*-acting, fixed position, fixed orientation
B) *trans*-acting, fixed position, fixed orientation
C) *cis*-acting, variable orientation, variable position
D) *cis*-acting, variable position, fixed orientation
E) *trans*- and *cis*-acting, variable position

31. A major difference between the *E. coli lac* and *ara* operons is that _____.
A) the substrate of the enzyme coded by *ara* is not the inducer
B) the *ara* regulator protein interacts with two regions of the operon
C) *ara* does not have a CAP-binding site
D) *ara* is expressed constitutively
E) *ara* does not have an operator site

32. Under strictly controlled conditions, a probe can be used that will hybridize only with its complementary sequence and not with other sequences that may vary by as little as one nucleotide. What are such probes called?
A) generation-specific probes B) short, variable repeats C) VNTRs
D) microsatellites E) allele-specific oligonucleotides (ASOs)

33. The human genome contains approximately 20,000 protein-coding genes, yet it has the capacity to produce several hundred thousand gene products. What can account for the vast difference in gene number and product number?
A) Alternative splicing occurs.
B) There are more introns than exons.
C) There are more exons than introns.
D) Much of the DNA is in the form of trinucleotide repeats, thus allowing multiple start sites for different genes.
E) Every gene can be read in both directions, and each gene can have inversions and translocations.

34. Following are four processes common to most cloning experiments. (a) transforming bacteria, (b) plating bacteria on selective medium, (c) cutting DNA with restriction endonucleases, (d) ligating DNA fragments. Which order would be the most likely occur during a cloning experiment.
A) abcd B) cdba C) acdb D) cdab

35. Assume that a plasmid (circular) is 3200 base pairs in length and has restriction sites at the following locations: 400, 700, 1400, 2600. Give the expected sizes of the restriction fragments following complete digestion.
A) 400, 800, 1000 (2 of these) B) 300, 700, 2200
C) 700, 400, 1400, 2600 D) 300, 700, 1000, 1200

三、解釋下列名詞 (10 %)

1. Restriction fragment length polymorphisms (RFLP)
2. Fluorescent *in situ* hybridization (FISH)
3. chromatin immunoprecipitation (ChIP) assay
4. cDNA library
5. polymerase chain reaction (PCR)

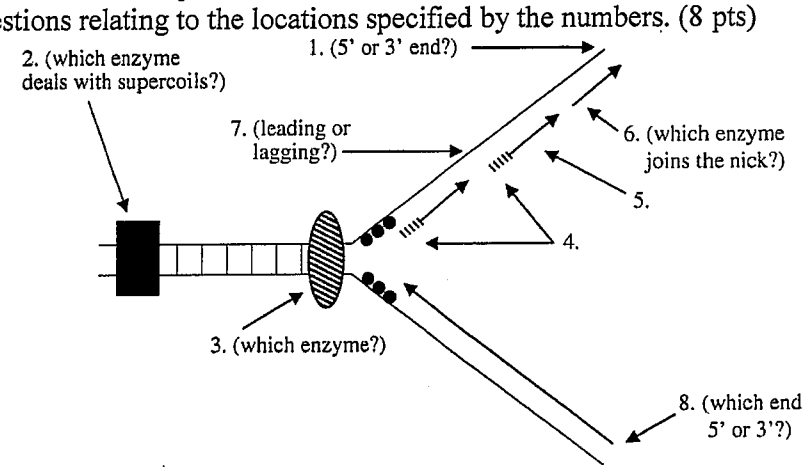
四、配合題 (6%): **Match up the important persons and their significant discoveries**

1. Avery
2. Watson and Crick
3. Frederick Griffith
4. Jacob and Monod
5. Howard Temin
6. Hershey and Chase

a. generate X-ray diffraction photograph of DNA
b. resolve a double-helical model for the structure of deoxyribonucleic acid
c. prove DNA replication is semiconservative.
d. proposed the regulation of the *lac* operon model to explain gene regulation
e. discover the retroviruses' replication involved in reverse transcriptase
f. discover the DNA polymerase for DNA replication
g. transformation experiment
h. identify transforming factor.
i. "radio-labelled phage" experiment to prove DNA carries genetic materials.

五、問答題(44%)

1. Below is a diagram of DNA replication in *E. coli*. From specific points, arrows lead to numbers. Answer the questions relating to the locations specified by the numbers. (8 pts)



(a) Which end (5' or 3') of the molecule is here?
(b) Which enzyme is probably functioning here to deal with supercoils in the DNA?
(c) Which enzyme is probably functioning here to unwind the DNA?
(d) Which nucleic acid is probably depicted here?
(e) What are these short DNA fragments usually called?
(f) Which enzyme functions here to couple these two newly synthesized fragments of DNA?
(g) Is this strand the leading or lagging strand?
(h) Which end (5' or 3') of the molecule is here?

2. List three major structural classifications of DNA-binding domains that are found in eukaryotic transcription factors. (3 pts)

3. Name three consensus sequences or modular DNA sequences that exist upstream from the coding regions of some eukaryotic genes. (3 pts)

4. Please describe the basic components of a cloning vector. (5pts)

5. Please describe how to use yeast two-hybrid system to identify protein-protein interaction? (hint: DNA binding domain (DBD), Activation domain (AD), reporter gene, such as *lacZ* or *Luciferase* gene) (5pts)

6. The following table lists several genotypes associated with the *lac* operon in *E. coli*. For each, indicate with a "+" or a "-" whether active β-galactosidase would be expected to be produced at induced levels. (Assume that glucose is not present in the medium.) (5 pts)

	β-galactosidase production	
Genotype	**No Lactose**	**with Lactose**
$I^+ O^+ Z^+$ (wild type)	--	+
a) $I^- O^+ Z^+$	___	___
b) $I^+ O^c Z^+$	___	___
c) $I^- O^+ Z^+ / F' I^+$	___	___
d) $I^- O^+ Z^+ / F' O^+$	___	___
e) $I^s O^+ Z^+$	___	___

I^+ = wild-type repressor

I^- = mutant repressor (unable to bind to the operator)

I^s = mutant repressor (insensitive to lactose)

O^+ = wild-type operator

O^c = constitutive operator (insensitive to repressor)

7. What is the difference between telomerase in cancer cells and telomerase in normal somatic cells of an adult, and what is the significance of that difference? (5 pts)

8. What does the term " replication licensing" refer to in the process of eukaryotic DNA replication? (5 pts)

9. In what types of cells do the piRNAs act? Why is it important to suppress transposition events in the germline? (5 pts)