

國立臺灣海洋大學 101 學年度研究所碩士班暨碩士在職專班入學考試試題

考試科目：分子生物學

系所名稱：食品科學系碩士班生技組

1. 答案以橫式由左至右書寫。2. 請依題號順序作答。

I. Multiple choices and one answer (單選, 2 points for each):

1. All of the following statements about gel electrophoresis are true **except**:
 - A. DNA migrates toward the positive electrode because it is negatively charged.
 - B. Molecular weight standards are used to determine the size of DNA molecules.
 - C. Polyacrylamide gels are used for DNA sequencing.
 - D. Agarose separates DNA molecules based on charge.
 - E. Ethidium bromide is used to visualize DNA.

2. Mismatch repair “knows” which strand is the daughter strand because it:
 - A. Is bound by the DNA polymerase III complex.
 - B. Is not methylated.
 - C. Consists of Okazaki fragments.
 - D. Contains an RNA primer.
 - E. None of the above.

3. If a researcher mated a mouse line containing a gene flanked by *loxP* sites with a line containing an inducible *cre* gene:
 - A. The Cre protein could be induced to remove the gene at a particular point in time.
 - B. The Cre protein would remove the gene in all tissues.
 - C. The progeny mice would die since this method of genetic manipulation is lethal in animals.
 - D. Nothing would happen because Cre protein interacts with FLP sites only.
 - E. None of the above.

4. Homologous recombination between a defective gene and a short oligonucleotide is a type of gene therapy known as:

- A. Gene filling.
- B. Oligo patching.
- C. Crossover patching.
- D. Oligo filling.
- E. Gene patching.

5. The most critical checkpoint in the cell cycle occurs at the:

- A. G_2 to mitosis transition.
- B. G_1 to G_0 transition.
- C. G_1 to S-phase transition.
- D. Mitosis to G_0 transition.
- E. S-phase to G_2 transition.

II. Please fill in the following questions: (填空, 2 points for each)

1. A commonly used protein tag in molecular biology is the His6- tag. This can be used to purify proteins because the His6 portion binds _____.
2. A genetic test for mutations in bacteria that is widely used for the detection of chemical mutagens is the _____.
3. When a section of DNA is damaged and polymerization cannot proceed, _____ repair can reconstitute the damaged replication fork.
4. tRNA molecules are extensively base-paired and are stabilized by hydrogen bonds and _____.
5. In prokaryotes, many of the repressors that bind to DNA contain the _____ motif.

III. Short answer: (解釋名辭, 2 points for each)

1. Autonomous transposons
2. Silencers
3. DNA microsatellites
4. Mismatch repair
5. Parental imprinting

IV. Questions need detailed answers include the principles, purpose, graphics and examples etc.

1. Please **briefly translate** the following short paper and **give your comments**. (翻譯及讀後心得, 8 points)

All proteins in eukaryotic cells are continually being degraded and replaced. Autophagy and the ubiquitin-proteasome system are two mechanisms for intracellular protein degradation. Autophagy is mediated by lysosome, and is further divided into chaperone-mediated autophagy, microautophagy and macroautophagy. The ubiquitin-proteasome system is highly complex and mediated by ubiquitin, which participates in intracellular protein degradation in a specific manner. It is now known that degradation of intracellular proteins is involved in regulation of a series of cellular processes, including cell-cycle division, DNA repair, cell growth and differentiation, quality control, pathogen infection, and apoptosis. The aberrations in the protein degradation systems are involved in many serious human diseases. The present review summarizes the mechanisms of protein degradation and related human diseases.

2. Briefly state the **principles** and **applications** of the follow molecular biotechnology. (原理及應用之說明, 3 points for each)

- (a) Affinity chromatography
- (b) Edman degradation
- (c) Electrophoretic mobility shift assay
- (d) Phage display

V. Single choice questions. (25%)

(1) Which of the following is a wrong statement regarding DNA?

- a. DNA replication is semi-conservative.
- b. DNA is usually double-stranded.
- c. DNA contains only 4 different nucleotides.
- d. DNA has the sugar ribose
- e. B form DNA is most common under the conditions found in cells

(2) RNA molecules that exhibit catalytic activity are called

- a. Ribonucleases
- b. Ribosomes
- c. Ribozymes
- d. Ribonucleotides
- e. All the above

(3) What is the root cause of sickle-cell anemia?

- a. It is not clear yet
- b. Mutations in the gene that directs the synthesis of the hemoglobin protein
- c. RNA interference
- d. Abnormally shaped red blood cells
- e. An amino acid substitution in the hemoglobin protein

(4) Which polymerase made widespread use of PCR possible:

- a. DNA polymerase I
- b. *Thermus aquaticus* (Taq) polymerase
- c. DNA polymerase III
- d. All of the above
- e. None of the above

(5) Promoter regions are nucleotide sequences that:

- a. Involved in the initiation of DNA replication
- b. Involved in transcription termination
- c. Contain the code for 1 mRNA molecule
- d. Important to the translation process

e. None of the above

(6) An enzyme that recognizes a specific (palindromic) sequence and cuts within a DNA molecule is

- a. Exonuclease
- b. Restriction enzyme
- c. DNA modification enzyme
- d. DNA ligase
- e. None of the above

(7) Which of the followings is accurate regarding Gregor Mendel?

- a. Selected *Pisum sativum* as his model organism for genetic studies
- b. His law of segregation states that when any individual produces gametes, the copies of a gene separate so that each gamete receives only one copy.
- c. His law of independent assortment states that alleles of different genes assort independently of one another during gamete formation.
- d. All of the above
- e. None of the above

(8) "Zinc fingers" are important in cellular regulation because they are

- a. Important in protein localization
- b. A structural motif in many DNA-binding proteins
- c. At catalytic sites of many kinases
- d. All of the above
- e. None of the above

(9) Which of the following is most likely to lead to a loss of gene function?

- a. A missense mutation in the open reading frame
- b. A change from A to G in the promoter region
- c. A change from A to G in the 3' untranslated region.
- d. A frameshift mutation in the coding region
- e. A substitution from TAA codon to a TAG codon in the coding region.

(10) Which of the following is accurate about the sigma factor in the RNA polymerase holoenzyme

of *E. coli*.

- a. Essential for termination of RNA transcript.
- b. Essential for the holoenzyme in recognition and binding to the promoter sequence.
- c. It keeps the core complex of RNA polymerase from dissociating.
- d. It increases RNA polymerase binding to any DNA template.
- e. There is only one type of sigma factors in *E. coli*.

VI. Multiple choices questions (15%)

(1) RNA splicing is process that

- a. Only happens in eukaryotes.
- b. Is catalyzed by Spliceosomes, group I introns and group II introns.
- c. Is inhibited by splicing factors SR protein (Serine-arginine rich proteins)
- d. Creates multiple isoforms from one gene.
- e. Has a constitutive pattern of splicing.

(2) Which of the followings is an accurate statement concerning transcription?

- a. Most RNA synthesis in eukaryotes is accomplished by RNA polymerase II
- b. Prokaryotic mRNA is usually polycistronic while eukaryotic mRNA is usually monocistronic
- c. Nucleosome is a general repressor in eukaryotic transcription
- d. Both strands of DNA can have promoter regions and encode proteins
- e. General transcription factors (GTFs) are necessary for prokaryotic and eukaryotic transcription to occur

(3) Which of the followings is an accurate statement concerning DNA replication?

- a. Okazaki fragments can be found in the leading strand
- b. No primer is required
- c. In a direction from 5' to 3'
- d. It is catalyzed by DNA polymerase which possesses exonucleases activity for proofreading
- e. DNA helicase catalyzes the separation of the two strands of DNA.

(4) Which of the following is an accurate statement concerning "genetic code"?

- a. It is read in a direction from 3' to 5'
- b. Message is translated in a fixed reading frame without gaps and overlaps
- c. The genetic code consists of 64 triplets of nucleotides

- d. The genetic code is universal in organelles of all organisms
- e. None of the above

(5) Mobile genetic elements, also called transposons:

- a. Usually lethal to the host
- b. Provide a source of genetic variation
- c. Can move with or without duplication of the element.
- d. An important cause of mutations leading to genetic disease
- e. Can be DNA-mediated or RNA-mediated

VII. Please describe briefly the major contribution of the following scientist. (10%)

- (1) Oswald T Avery
- (2) James Watson and Francis Crick
- (3) Alfred Hershey and Martha Chase
- (4) Marshall W. Nirenberg and Heinrich Matthaei
- (5) Wendell M. Stanley