

國立臺灣海洋大學一〇二學年度研究所碩士班暨碩士在職專班招生考試試題

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。

第一部份

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

1. The following statements are true regarding nucleotides.
 - a. Purine-containing nucleotides on each strand of double-stranded DNA base pair with each other.
 - b. UTP, GTP and ATP act as stores of energy.
 - c. Nucleotides containing adenine, cytosine, guanine and thymine are found in ribonucleic acids.
 - d. They are not involved in cell signaling.
 - e. They are glycosylated like proteins to modify function.

2. The following statements are true regarding transcription in eukaryotes.
 - a. It is initiated at the start (ATG) codon.
 - b. It only occurs in the nucleus.
 - c. It is the process by which DNA is copied into DNA.
 - d. RNA polymerase II transcribes genes destined for translation.
 - e. It requires the 60S ribosomal subunit.

3. The following statements are wrong regarding the initiation of eukaryotic genome replication.
 - a. Occurs in the S phase of the cell cycle.
 - b. Occurs at a single place on each chromosome.
 - c. Occurs at specific DNA sequences.
 - d. Results in the emergence of two replication forks that progress in opposite directions.
 - e. Is controlled by checkpoints in the cell cycle.

4. Gene expression (i.e. the generation of a functional protein from a gene) can be controlled at the level of.

- a. Protein modification.
- b. Transcription.
- c. Messenger RNA modification.
- d. Translation.
- e. all of the above.

5. Are the following wrong associations between post-transcriptional modifications of heteronuclear RNA and the function of these modifications in eukaryotes?

- a. 3' polyadenylation and 5' capping/increases stability of transcript.
- b. Capping of the 5' end/prevents rapid mRNA degradation.
- c. 3' polyadenylation/promotes binding of transcript to ribosome.
- d. Capping of the 5' end/promotes binding of transcript to ribosome.
- e. 3' polyadenylation/export of transcript to cytoplasm via the nuclear pore.

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

- 1. A _____ is one that converts a codon for an amino acid to a stop codon, thus terminating the polypeptide chain prematurely.
- 2. _____ - an aminoglycoside antibiotic - induces mRNA misreading. Resulting mutant proteins slow the rate of bacterial growth.
- 3. _____ precede and follow polymerase to relieve supercoiling.
- 4. Genes for enzymes for pathways are grouped in clusters on the chromosome - called _____.
- 5. The time lapse between infection and release of progeny is called the latent period, and the number of phage released is called the _____.

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

1. Ribozyme
2. DNA shuffling
3. Intercalating agents
4. Morphogens
5. Double-strand break repair model

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)

p53 functions as a transcription factor involved in cell-cycle control, DNA repair, apoptosis and cellular stress responses. However, besides inducing cell growth arrest and apoptosis, p53 activation also modulates cellular senescence and organismal aging. Senescence is an irreversible cell-cycle arrest that has a crucial role both in aging and as a robust physiological antitumor response, which counteracts oncogenic insults. Therefore, via the regulation of senescence, p53 contributes to tumor growth suppression, in a manner strictly dependent by its expression and cellular context. In this review, we focus on the recent advances on the contribution of p53 to cellular senescence and its implication for cancer therapy, and we will discuss p53's impact on animal lifespan. Moreover, we describe p53-mediated regulation of several physiological pathways that could mediate its role in both senescence and aging.

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) Gel filtration chromatography
- (b) Two-dimensional gel electrophoresis
- (c) Chromosome walking
- (d) Enzyme-linked immunosorbent assay

第二部份

1. Single choice questions. (25%)

(1) Polymerase chain reaction is catalyzed by

- a. DNA polymerase
- b. RNA polymerase
- c. Ribosome
- d. Degradosome
- e. None of the above

(2) Which of the following is true regarding the genetic code?

- a. Genetic code is universal in all organisms
- b. The code can be overlapping
- c. There are 61 different tRNAs to base pair with 61 sense codons in *E. coli*
- d. One code may encode for 1-6 amino acids.
- e. None of the above

(3) Promoter regions of DNA are the nucleotide sequences that

- a. is involved in the initiation of translation
- b. is involved in the interaction with DNA polymerase holoenzyme
- c. melts during initiation of transcription
- d. forms hairpin structure in order to perform its biological role
- e. None of the above

(4) Alternative RNA processing may result in

- a. the production of two or more proteins with identical function
- b. the production of more than one isoforms from a single gene
- c. huge elongation of pre-mRNA
- d. The production of the same protein from two different genes
- e. Attachment of the poly(A) tail to the 5' end of an mRNA

(5) Which of the followings is most likely to lead to a loss of gene function?

- a. A sequence change in the 3' untranslated region
- b. A point mutation in the promoter region
- c. A missense mutation in the open reading frame
- d. A nonsense mutation in the middle of the coding region

e. All of the above

(6) The function of chaperone proteins is to

- a. protect unfolded proteins from aggregating
- b. ensure proper ribosome assembly
- c. escort aminoacyl-tRNA to the ribosome
- d. protect rRNA from degradation by RNases
- e. None of the above

(7) Which of the following is true regarding *trp* operon in bacteria?

- a. *tryB* gene encodes for SecB chaperone protein
- b. Attenuation is a mechanism of negative feedback in the *trp operon*
- c. Tryptophan repressor can bind to operator in the absence of tryptophan
- d. The *trp* operon contains gene responsible for the breakdown of tryptophan
- e. All of the above

(8) Please choose the true description regarding mRNA processing.

- (a) It is happening both in eukaryotes and prokaryotes
- (b) It is post-translational
- (c) Some of the elongation factors mediate the steps of mRNA processing by phosphorylation and dephosphorylation of CTD of RNA polymerase.
- (d) Poly(A) tails of mRNA protects mRNA from 5' exoribonuclease
- (e) None of the above

(9) Which of the followings is not true regarding riboswitches?

- a. Riboswitches are most often located in the 5' untranslated region
- b. A riboswitch can adopt different secondary structures to effect gene regulation
- c. Magnesium ions and amino acids can be the ligands sensed by riboswitches
- d. Riboswitches are RNA
- e. It is present only in prokaryotes

(10) The scientists who deciphered the genetic code are

- a. James Watson and Francis Crick
- b. Marshall W. Nirenberg and Heinrich Matthaei
- c. Wendell M. Stanley

d. Oswald T Avery

e. Alfred Hershey and Martha Chase

2. Please choose the one (on the right) that applies (the left). (Single choice) (10%)

- | | |
|----------------------|---|
| (1) SR proteins | A. RNA molecules inhibit gene expression |
| (2) RNA interference | B. The denaturation of DNA |
| (3) EF-TU | C. Delivery of charged tRNA in translation |
| (4) Lac repressor | D. Activators of pre-mRNA splicing |
| (5) Homeodomain | E. Release factors |
| | F. Lipid metabolism |
| | G. Nonstop-mediated decay |
| | H. Contain helix-turn-helix motif |
| | I. Can bind to operator to stop the transcription |
| | J. Can cause frameshift mutation |

3. Please define the following terms briefly. (15%)

- a. Zinc finger proteins
- b. Wobble base pairing
- c. Basic Local Alignment Search Tool (BLAST) algorithm
- d. complementary DNA
- e. Gene

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考試科目： 微生物學

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。

1. Please define and/or explain the following terms: (24%)
 - 1A. Phage typing and fluorescent in situ hybridization
 - 1B. Mutation and selection
 - 1C. Viruses and prions
 - 1D. Electroporation and protoplast fusion
 - 1E. Bioreactors and biofuels
 - 1F. Bacteria and Archaea
 - 1G. Induction and repression
 - 1H. Biotechnology and DNA technology
2. Please compare the real-time PCR and the reverse-transcription PCR. (6%)
3. Please state and compare the DNA vaccines and live attenuated vaccines. (6%)
4. Please differentiate conjugation, transduction, and transformation. (7%)
5. Please describe and differentiate the following terms: genus, species, culture, clone, and strain. (7%)
6. Please describe the protocols and underlying mechanisms for Gram staining and acid-fast staining. (10%)
7. Please explain why penicillin, a “miracle drug”, does not harm human cells. (10%)
8. Please draw a G(-) bacterial cell structure and indicate the locations where (1) capsule, (2) periplasmic space, (3) ribosome, (4) nucleoid, and (5) peritrichous flagella are. (10%)

9. Compare and contrast the following items (5% for each)

(1) Flagella structures between prokaryote and eukaryote

(2) Plasmolysis vs. osmolysis

(3) Facilitated diffusion vs. active transport

(4) Energy production by fermentation vs. by aerobic respiration in *Escherichia coli*