

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：生物化學

系所名稱：水產養殖學系碩士班生命科學組

1. 答案以橫式由左至右書寫。2. 請依題號順序作答。

一、選擇題 (1) 每題 1 分

1. Which one of the followings is not true to describe "protein translation in vivo" (A). need mRNA, rRNA, and tRNA work together (B). methionine is the first amino acid to be synthesized (C). carry in the cytosol (D). tRNAs have the most modified base (E). protein elongation from the carboxyl group to the amino group.
2. Which one of the followings is not true to describe the "characteristics of eucaryotic nucleic acid" (A). RNA exists in single strand (B). RNA is DNA transcriptional product (C). the 2' ribose moiety of RNA contains -OH group (D). RNA is less stable than DNA (E). RNA is less stable in acidic solution.
3. Which one of the followings is not true to describe "characteristics of DNA expression vector" (A). containing OriC site for amplification (B). containing MCS site for cloning (C). containing promoter sequence (D). containing antibiotic selection sequence (E). containing splicing sequence.
4. Which one of the followings is not true to describe "eucaryotic DNA transcription" (A). to synthesis rRNA (B). to synthesis tRNA (C). with posttranscriptional modification (D). transcriptional region can call as gene unit (E). to synthesis protein.
5. Which one of the followings is not true to describe "nucleic acid electrophoresis" (A). DNA carry negative charge (B). separation based on the length (C). need DNA or RNA marker (D). visible under UV light by staining with EtBr (E). RNA carry positive charge.
6. Which one of the followings is not true to describe "characteristics of nucleic acid" (A). can be single stranded RNA (B). can be antiparallel double stranded DNA (C). all linked by phosphodiester bond (D). all are in 5 → 3 orientation (E). DNA is more stable than RNA.
7. Which one of the followings is not true to describe "polymerase chain reaction" (A). need dNTP as substrate (B). synthesis double strand DNA (C). need DNA primer (D). need DNA helicase (E). need a DNA template.
8. Which one of the followings is not true in "in vivo DNA replication" (A). semiconservative (B). need SSB proteins to stabilize ssDNA in lagging strand (C). producing leading and lagging strand in different orientation (D). DNA is the replication initiation primer (E). both strand carry out by DNA polymerase.
9. Which one of the followings is not true to describe the techniques of "blotting and detection" (A). Southern blot is used for gene copy detection in genomic DNA (B). Northern blot is used for detect gene transcript (C). detection can be isotopic or nonisotopic (D). the transfer membrane usually cover with positive charge chemicals (E). Western blot is used for detect protein in gene translation.

10. Which one of the followings is not used in “cellular DNA replication” (A). helicase (B). RNase H. (C). ligase (D). RNA polymerase (E). primase.
11. Which one of the followings is not true to describe the “prokaryotic genomic structure” (A). prokaryotic transcription can be polycistronic (B). prokaryotic genome replicate as  $\theta$  type with two direction of replication (C). contain movable DNA elements, such as plasmid and transposon (D). genomic DNA replication need primer (E). an operon structure can transcribe with one gene.
12. Which one of the followings is not true to describe the “TCA cycle” (A). the most important cycle for amino acid synthesis (B). one of the important cycle to generate macromolecule precursors (C). the most important cycle to produce carbon dioxide (D). the most important cycle to generate high energy molecules (E).  $\alpha$ -ketoglutarate and citrate are important precursors for nucleic acid synthesis.
13. Which one of the followings is not true to describe “acetyl -CoA” (A). glycolysis final product to enter TCA cycle (B). fatty acid  $\beta$ -oxidation product (C). precursor of malonyl-CoA for fatty acid synthesis (D). precursor of ketone body (E). precursor of malate.
14. Which one of the followings is not true to describe the “anabolic organization in cell” (A). essential fatty acid can not be synthesized from glucose (B). nonessential amino acid can be synthesized from glucose (C). glucose can be generated from lipid (D). glucose can be generated from protein (E). essential amino acid can be generated from essential fatty.
15. Which one of the followings is not used in “DNA sequencing by enzymatic method” (A). nonisotopic labeled ddNTP (B). DNA polymerase (C). with a single DNA primer (D). regular dNTP (E). RNA polymeras.
16. Which one of the followings is not to list as “essential amino acid” (A). isoleucine (B). lysine (C). histidine (D). glutamine (E). valine.
17. Which one of the followings is not true to describe the “metabolic regulation” (A). catabolism is to produce ATP and precursors (B). synthesis those can not supply from environment (C). anabolism is to synthesize macromolecule (D). anabolism and catabolism both carry out in the cytosol (E). control of gene transcription is the most important.
18. Which one of the followings is not true to cause “ DNA polymorphism or mutation in vivo” (A). DNA replication error (B). DNA crossing over (C). movable DNA elements (D). missense mutation (E). polymerase fidelity.
19. Which one of the followings is not true to describe “the cellular reactions” (A). obey the law of thermodynamics (B). follow the metabolic regulation (C). need ATP as energy form in the endergonic reaction (D). change the reaction direction by enzymes (E). follow the redox potential.
20. Which one of the followings is not true to describe “gene is defined as a transcriptional unit” (A). mainly carry out by RNA polymerase (B). open the initiation site, the +1 position, by many proteins. (C). the upstream of “+1 position” is called promoter (D). used for mRNA only, not for tRNA or rRNA (E). terminated at termination site by unique sequence and proteins.

二、選擇題 (2) : (1 point each)

1. Which of the following pairs would be the best buffer at pH 10.0?

- a. Acetic acid and sodium acetate ( $pK_a = 4.76$ )
- b.  $H_2CO_3$  and  $NaHCO_3$  ( $pK_a$ s are 3.77 and 10.4)
- c. Lactic acid and sodium lactate ( $pK_a = 3.86$ )
- d.  $NaH_2PO_4$  and  $Na_2HPO_4$  ( $pK_a$ s are 2.1, 7.2, 12.4)
- e. Sodium succinate and succinic acid ( $pK_a = 4.21$ )

2.  $pH = pK_a$  when:

- a.  $[A^-]/[HA] = 0$
- b.  $\log([A^-]/[HA]) = 1$
- c.  $[A^-] \gg [HA]$
- d.  $[A^-] = [HA]$
- e.  $\log([HA]/[A^-]) = 1$

3. All are true for the Second Law of Thermodynamics EXCEPT:

- a. Systems tend to proceed from ordered states to disordered states.
- b. The entropy of the system plus surroundings is unchanged by reversible processes.
- c. The entropy of the system plus surroundings increases for irreversible processes.
- d. All naturally occurring processes proceed toward equilibrium.
- e. None, all are true.

4. Which equation defines a system at equilibrium?

- a.  $\Delta G > 0$
- b.  $\Delta G^\circ = \Delta G$
- c.  $\Delta G = 0$
- d.  $\Delta G^\circ = 0$
- e.  $\Delta G = RT \ln([products]/[reactants])$

5. The  $pK_a$  of the cysteine side chain \_\_\_\_\_ group is 8.32, so it is about 12% dissociated at pH \_\_\_\_\_.

- a. acid, 3.2
- b. amino, 8.5
- c. hydroxyl, 10.2
- d. sulfhydryl, 7
- e. none of the above

6. Where  $C_\alpha$  is the  $\alpha$ -carbon, N represents the amide nitrogen and  $C_o$  is the carbonyl carbon of amino acids in a peptide, the peptide backbone of a protein consists of the repeated sequence:

- a.  $-C_\alpha-N-C_o-$
- b.  $-N-C_o-C_\alpha-$
- c.  $-N-C_\alpha-C_o-$
- d.  $-C_o-C_\alpha-N-$
- e. none of the above

7. Globular proteins are usually all EXCEPT:

- a. Insoluble in water.
- b. Roughly spherical.

- c. Folded so that the hydrophobic amino acids are in the interior of the molecule.
- d. Hydrophobic side chains are exposed to the water.
- e. None, all are true.

8. Edman degradation will:

- a. determine the C-terminal amino acid by using a carboxypeptidase.
- b. cleave the protein into a multitude of smaller peptides.
- c. compare overlapping sets of peptide fragments.
- d. determine the N-terminal amino acid.
- e. generate two different, but overlapping sets of peptide fragments.

9. Reaction of the peptide, ala-met-lys-ser, with phenylisothiocyanate (PITC) at pH 8.0 followed by mild acidification (first cycle of Edman method) would release:

- a. the labeled peptide ala-met-lys-ser- PTH.
- b. PTH-ala, PTH-ser, PTH-lys and PTH-met.
- c. PTH-ser and the peptide ala-met-lys.
- d. PTH-ala and the peptide met-lys-ser.
- e. All of the above.

10. Insulin is a polypeptide hormone that contains two short polypeptide chains linked by two interstrand disulfide bonds. The most logical order of events to perform in order to sequence this protein would be:

- A: The peptides are reduced with mercaptoethanol.
- B: The peptides are sequenced using Edman chemistry.
- C: The peptides are separated by chromatography techniques.
- D: The peptides are alkylated with iodoacetamide.

- a. A, D, C, B
- b. C, A, D, B
- c. C, B, A, D
- d. A, B, C, D
- e. A, C, D, B

11. Determine the amino acid sequence of the following oligopeptide from the experimental data below.

The amino acid composition is found to be [ala, lys, phe, met, cys, plus some decomposition products].

The peptide has a molecular weight around 700 Da and absorbs at 280 nm.

Treatment with carboxypeptidase results in tryptophan and a peptide.

CNBr treatment yields a tetrapeptide and a dipeptide.

Trypsin digestion produces an amino acid and a pentapeptide with met on the amino end.

Chymotrypsin digestion yields a dipeptide and a tetrapeptide.

- a. trp-lys-met-cys-met-ala
- b. lys-met-cys-phe-ala-trp

- c. trp-ala-phe-cys-met-lys
  - d. lys-ala-cys-phe-met-trp
  - e. lys-met-cys-ala-phe-trp
12. Homologous proteins such as hemoglobin from different organisms do NOT:
- a. have nearly identical lengths.
  - b. share little sequence homology with other proteins with similar function (e.g., myoglobin).
  - c. share a significant degree of sequence similarity.
  - d. perform the same function in different organisms.
  - e. have sequence identity in direct correlation to the relatedness of the species from which they were derived.
13. The resonance structure which forms the "amide plane" contains which atoms?
- a.  $C_{\alpha}H-NH-CO-C-C_{\alpha}H$
  - b.  $C_{\alpha}H-NH-CO$
  - c.  $C_{\alpha}-NH-CO-C_{\alpha}$
  - d.  $NH-CO$
  - e.  $NH-CO-C_{\alpha}$
14. A Ramachandran plot shows:
- a. the amino acid residues which have the greatest degree of rotational freedom.
  - b. the sterically allowed rotational angles between R groups and  $\alpha$ -carbons in a peptide.
  - c. the sterically allowed rotational angles between  $C_{\alpha}$  and the amide nitrogen ( $C_{\alpha}-N$ ) as well as between  $C_{\alpha}$  and the amide carbonyl carbon ( $C_{\alpha}-CO$ ).
  - d. the sterically allowed rotational angles about the amide nitrogen (NH) and CO.
  - e. the amino acid residues that form  $\alpha$ -helix,  $\beta$ -sheet, etc.
15. When the peptide (AEFFLAMPEP) forms an  $\alpha$ -helix, which amino acid residue would be closest to being in the same position on the same face of the helix as is the initial alanine residue?
- a. F(3)
  - b. A(6)
  - c. E(8)
  - d. P(9)
  - e. L(5)
16. Antiparallel  $\beta$ -sheets have:
- a. sheets that progress from N to C termini in the same direction.
  - b. usually all of their hydrophobic residues on one side of the sheet.
  - c. all hydrophobic residues.
  - d. all hydrophilic residues.
  - e. fibers that can be stretched or extended, but are not flexible.
17. Polylysine is a random coil when the pH is less than 11, while it forms an  $\alpha$ -helix if the pH is raised to greater than 12. This is because at pH 12:
- a. the lysine residues are negatively charged which electrostatically stabilizes the helix.
  - b. the positive charges on the lysine residues stabilizes the  $\alpha$ -helix.
  - c. the lysine residues are neutral which eliminates electrostatic repulsion between the R groups.
  - d. the high concentration of  $OH^-$  ions in solution reduces the electrostatic repulsion between the R-groups.
  - e. the lysine side chain changes configuration with pH.

18. Silk fibers consist of \_\_\_\_\_ proteins consisting of alternating \_\_\_\_\_ and \_\_\_\_\_ or \_\_\_\_\_ residues.
- fibroin; glycine; proline; leucine
  - $\alpha$ -keratin; alanine; glycine; serine
  - fibroin; glycine; alanine; threonine
  - $\beta$ -keratin; cysteine; alanine; proline
  - fibroin; glycine; alanine; serine
19. In hemoglobin, a \_\_\_\_\_ protein, the space between the helices is filled efficiently and tightly with mostly \_\_\_\_\_ amino acid chains and with \_\_\_\_\_ side chains facing the outside of the protein structure.
- globular, hydrophobic, polar
  - globular, polar, nonpolar
  - fibrous, hydrophobic, nonpolar
  - fibrous, polar, nonpolar
  - none are true
20. Which statement is correct about the  $\beta$ - $\alpha$ - $\beta$  motif?
- The two  $\beta$ -strands are antiparallel.
  - The peptide segment connecting the  $\beta$ -strands usually contains no more than five amino acids.
  - The peptide segment connecting the two  $\beta$ -strands commonly contains proline.
  - The cross-over connection itself contains an  $\alpha$ -helical segment.
  - none are correct.
21. Arrange the steps involved in folding of globular proteins into a proper sequence.
- "Molten globule" formation of assembled domains.
  - Formation of domains through cooperative aggregation of folding nuclei.
  - Adjustment in the conformation of domains.
  - Rapid and reversible formation of local secondary structure.
  - Final protein monomer formation.
- A, B, C, D, E
  - B, C, E, A, D
  - D, C, B, A, E
  - D, B, A, C, E
  - B, D, C, A, E
22. Cellulose is a:
- (1 $\rightarrow$ 4)- $\alpha$ -D-mannopyranan.
  - (1 $\rightarrow$ 4)- $\beta$ -D-glucopyranan.
  - (1 $\rightarrow$ 6)- $\alpha$ -D-glucopyranan.
  - (1 $\rightarrow$ 4)- $\beta$ -D-galactopyranan.
  - (1 $\rightarrow$ 6)- $\alpha$ -D-mannopyranan.
23. In plant cells, starch is hydrolyzed by \_\_\_\_\_ to release \_\_\_\_\_ and a starch molecule with \_\_\_\_\_.
- starch phosphorylase; glucose-1-phosphate; one less glucose unit
  - salivary  $\alpha$ -amylase; maltose 1-phosphate; two less glucose units
  - starch phosphorylase; maltose 1-phosphate; two less glucose units

- d.  $\alpha(1\rightarrow6)$  glucosidase; glucose-6-phosphate; one less glucose unit  
e. starch hydrolase; glucose; one less glucose unit
24. Cooked starch is more digestible because:  
a. it has been partially hydrolyzed during cooking.  
b. the amylopectin is converted to amylose during cooking.  
c. the enzymes that hydrolyze the starch are only active when the starch is hot.  
d. the starch granules take up water, swell and are more accessible to the enzymes.  
e. all are true.
25. \_\_\_\_\_ is an enzyme found in liver and muscle tissue used to catalyze the hydrolysis of glycogen to \_\_\_\_\_.  
a.  $\beta(1\rightarrow6)$ -Glucosidase; glucose-1-phosphate  
b.  $\alpha$ -Amylase; glucose-1-phosphate  
c.  $\beta$ -Amylase; glucose  
d. Glycogen maltase; maltose  
e. Glycogen phosphorylase; glucose-1-phosphate
26. Which of the following statements about cellulose fiber is true?  
a. It is a linear polymer of  $\beta(1\rightarrow4)$  glycosidic linked glucose and galactose residues.  
b. It is extremely susceptible to hydrolysis.  
c. It is water-soluble.  
d. It is made up of very weak microfibrils.  
e. Intermolecular hydrogen bonds play a major role in stabilization of the microfibrils.
27. \_\_\_\_\_ and \_\_\_\_\_ are found in tendons, cartilage and other connective tissue.  
a. Heparin; chondroitins  
b. Chondroitins; keratin sulfate  
c. Keratin sulfate, dermatan sulfate  
d. Hyaluronate, keratin sulfate  
e. All are true.
28. The core protein of a proteoglycan is noncovalently attached to:  
a. oligosaccharides.  
b. glycosaminoglycans.  
c. keratin sulfate.  
d. an outer protein.  
e. hyaluronic acid backbone.
29. Glycosphingolipids consist of a \_\_\_\_\_ with one or more \_\_\_\_\_ residues in a \_\_\_\_\_ linkage at the 1-hydroxyl moiety.  
a. sugar; fatty acids; ester  
b. ceramide; sugar;  $\beta$ -glycosidic  
c. ceramide; fatty acid; amide  
d. glycerol; fatty acids; ester  
e. none are true
30. Plant sterols are:  
a. so similar to cholesterol that they undergo the same physiology and metabolism.  
b. different isomers of cholesterol at the double bond location only.

- c. to be avoided in your diet because they elevate blood cholesterol levels.
- d. highly effective in blocking the absorption of cholesterol by intestinal cells.
- e. none are true.

31. In eukaryotic cells phospholipids, glycolipids and cholesterol are synthesized by enzymes located in the \_\_\_\_\_ and \_\_\_\_\_, and flow of these components to other membranes in the cell is mediated by \_\_\_\_\_.

- a. plasma membrane; mitochondria; osmosis
- b. endoplasmic reticulum; Golgi; osmosis
- c. plasma membrane, Golgi; lipid transfer proteins
- d. endoplasmic reticulum; Golgi; lipid transfer proteins
- e. endoplasmic reticulum; plasma membrane; flippases

32. A method used to insert or transform cells with a plasmid is to:

- a. add the DNA to bacterial cells that have been lightly treated with lysozyme to produce "holes" in the cell wall.
- b. add the DNA to a heated suspension of cells at 42° C.
- c. treat the bacteria with  $Ca^{2+}$ , add the DNA, and briefly heat to 42° C.
- d. incubate the DNA with the cells overnight at 4° C.
- e. mixing plasmids with an extract of broken cells.

33. All are steps in the sequence for construction of a chimeric plasmid EXCEPT:

- a. annealing the ends of the vector and foreign DNA.
- b. cutting the source of the foreign DNA with a restriction endonuclease.
- c. reannealing the ends of the vector back together.
- d. cutting the vector plasmid with the same restriction endonuclease.
- e. none of the above.

34. A genomic DNA library is:

- a. a collection of short fragments from nuclear DNA digestion.
- b. arrays of synthetic oligonucleotides used to select for a specific DNA.
- c. a set of cloned fragments that collectively represent the genes of a particular organism
- d. a short segment of DNA whose sequence is complementary to a portion of the DNA of interest.
- e. a circular DNA molecule of 1 kb to 200 kb found in bacteria and yeast cells.

35. The correct sequence for colony hybridization experiments is:

- A. A replica of the bacterial colonies is obtained on an absorbent disc.
- B. Autoradiography of the disc reveals probe complementary DNA.
- C. Host bacteria with plasmid are plated and allowed to grow overnight.
- D. The disc is treated with alkali.
- E. The disc is reacted with labeled probe.

- a. A, C, E, B, D
- b. C, A, E, D, B
- c. C, E, A, B, D
- d. C, A, E, B, D
- e. C, A, D, E, B

36. The correct sequence of procedures in the Southern blotting (hybridization) technique is:

- A. hybridization with radioactive probe.

- B. agarose gel electrophoresis and visualize bands.
- C. transfer (blot) to nitrocellulose filter.
- D. digest DNA with restriction nucleases.
- E. expose filter to X-ray film, develop and observe.

- a. B, A, C, E, D
- b. D, C, B, A, E
- c. C, D, B, E, A
- d. D, B, C, A, E
- e. A, B, C, D, E

37. RT-PCR differs from basic PCR in that:

- a. reverse temperatures are used for annealing and transcription.
- b. transcription is reversed from 5' to 3' ends.
- c. reverse transcriptase is used to synthesize a cDNA strand complementary to an RNA strand.
- d. reverse transcriptase is used to synthesize an RNA strand from the DNA strand.
- e. none of the above.

38. The correct sequence for homologous recombination steps is:

- A. ligation.
  - B. branch migration and strand exchange.
  - C. nicking.
  - D. EW or NS cleavage, resolution and re-ligation.
  - E. strand invasion.
- a. B, C, E, A, D
  - b. C, B, E, D, A
  - c. D, C, B, A, E
  - d. C, E, A, B, D
  - e. C, A, B, E, D

39. The initial event in the conversion of an hnRNA to the mature RNA which leaves the nucleus is:

- a. formation of ribonucleoprotein particles (RNPs).
- b. capping the 5'-end of the transcript with a guanylyl group by guanylyl transferase.
- c. addition of a poly(A) tail to the 3'-end of the transcript by poly(A) polymerase.
- d. splicing together of the exons.
- e. transesterification reactions in lariat formation.

40. The appropriate order for the basic steps of protein synthesis are:

- A. The elongation reaction transfers the peptide chain from the peptidyl-tRNA in the P site to the aminoacyl-tRNA in the A site.
- B. The P site is occupied by peptidyl-tRNA carrying the growing polypeptide chain.
- C. Binding of mRNA by the small subunit followed by association of a particular initiator aminoacyl-tRNA that recognizes the first codon.
- D. The large ribosomal subunit joins the initiation complex, preparing it for the elongation stage.
- E. The new, longer peptidyl-tRNA moves from the A site into the P site as the ribosome moves one codon further along the mRNA.

- a. A, C, E, B, D
- b. B, E, C, D, A

- c. C, D, A, B, E
- d. D, C, E, B, A
- e. C, D, B, A, E

### 三、問答題

1. Part of the medical treatment for methanol poisoning is to administer ethanol in amounts large enough to cause intoxication under normal circumstances. Explain this in terms of what you know about examples of enzymatic reactions. (5 %)
2. What is a zymogen? Explain briefly with an example. (5 %)
3. In a tissue where the TCA cycle has been inhibited by fluoroacetate, what different in the concentration of each TCA cycle metabolite would you expect, compared with a normal, uninhibited tissue? (5 %)
4. Why is it more efficient to store energy as lipid rather than as glycogen? (5 %)
5. 2-bromopalmitoyl-CoA inhibits the oxidation of palmitoyl-CoA by isolated mitochondria but has no effect on the oxidation of palmitoylcarnitine. What is the most likely site of inhibition by 2-bromopalmitoyl-CoA? (5 %)
6. Which vitamin is central in amino acid catabolism? Why? (5 %)
7. How does sulfanilamide inhibit bacterial growth? (5 %)
8. Why may it be important to exclude uracil from DNA? (5 %)