

國立臺灣海洋大學 103 學年度研究所碩士班招生考試試題

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、問答題 (50%)

1. Enzyme A follows simple Michaelis-Menten kinetics. The K_m of enzyme A for its substrate S is $K_m^S = 10$ mM. Enzyme A also acts on substrate P and its $K_m^P = 100$ mM. Is S or P the preferred substrate for enzyme A? Why? (5 %)
2. How does destabilization of ES affect enzyme catalysis? (5 %)
3. Describe the epinephrine triggers hormone-activated enzymatic cascade that leads to activation of glycogen phosphorylase. (8 %)
4. What is the coenzyme required in the pyruvate carboxylase reaction? (2 %)
5. How do long-chain fatty acids transport from cytoplasm into mitochondria? (6 %)
6. Which fatty acid is the precursor of prostaglandins (Eicosanoids)? And where is the fatty acid from? (4 %)
7. Describe the reactions of the urea cycle. (6 %)
8. Phenylketonuria is a human genetic disease. The urine of the victim contains excessive phenylpyruvate. Please describe what is the defect of this genetic disease. (4 %)
9. The major pathways of purine catabolism in animals lead to uric acid formation. The most common symptom of gout is arthritic pain in the joints as a result of uric acid deposition in cartilaginous tissue. However, a common treatment is allopurinol. Can you describe the mechanism of allopurinol. (5 %)
10. How are the specificity and catalytic activity of ribonucleotide reductase regulated by nucleotide binding (ATP, dATP, dTTP.....)? (5 %)

二、選擇題 (50%每題 1 分)

1. Intracellular pH is maintained primarily by the _____ and _____ buffer systems, and the extracellular pH by the _____ buffer system.
 - a. $\text{HPO}_4^{2-}/\text{H}_2\text{PO}_4^-$; $\text{HCO}_3^-/\text{H}_2\text{CO}_3$; histidine
 - b. $\text{H}_3\text{PO}_4/\text{H}_2\text{PO}_4^-$; histidine; $\text{HCO}_3^-/\text{H}_2\text{CO}_3$
 - c. $\text{HCO}_3^-/\text{H}_2\text{CO}_3$; $\text{H}_3\text{PO}_4/\text{H}_2\text{PO}_4^-$; histidine
 - d. $\text{HPO}_4^{2-}/\text{H}_2\text{PO}_4^-$; histidine; $\text{HCO}_3^-/\text{H}_2\text{CO}_3$
 - e. $\text{HCO}_3^-/\text{H}_2\text{CO}_3$; histidine; $\text{H}_3\text{PO}_4/\text{H}_2\text{PO}_4^-$
2. If equal amounts of Na_2HPO_4 and Na_3PO_4 are mixed in water, calculate the resulting pH. The pKas of phosphoric acid are 2.1, 7.2, 12.4.
 - a. 7.0
 - b. 12.4
 - c. 4.5
 - d. 9.5
 - e. 3.6

3. Thermodynamic parameters (entropy, enthalpy, free energy, and internal energy) are given for an unknown enzyme. Explain which results would be expected for the breaking of hydrogen bonds and the exposure of hydrophobic groups from the interior during the unfolding process of a protein.

- a. Entropy change, ΔS , is zero
- b. Enthalpy change, ΔH , is positive
- c. The reaction is spontaneous
- d. Enthalpy change, ΔH , is negative
- e. Entropy change, ΔS , is positive

4. The metabolite with a lower ΔG° of hydrolysis than ATP is:

- a. acetyl phosphate.
- b. phosphoenol pyruvate (PEP).
- c. phosphocreatine.
- d. adenosine-5'-phosphate.
- e. pyrophosphate.

5. Glutamic acid has pKas at 2.2, 4.3 and 9.7. Calculate the isoelectric point for glutamic acid.

- a. 3.25
- b. 4.3
- c. 5.4
- d. 7.0
- e. 8.6

6. Which of the peptides would absorb light at 280 nm?

- a. ala-lys-his
- b. ser-gly-asn
- c. ala-ala-trp
- d. val-pro-leu
- e. ser-val-ile

7. Ninhydrin has all these properties **EXCEPT**:

- a. It reacts with an amino acid by oxidatively deaminating its amino group.
- b. It can be used to detect the location of amino acids following chromatography.
- c. It produces a purple colored product upon reaction with alanine.
- d. It produces a yellow product upon reaction with histidine.
- e. It can be used to quantify most amino acids.

8. Fibrous proteins, such as collagen, have which one of the following properties?

- a. Highly soluble in water.
- b. Their hydrophilic residues are directed into the interior of the protein.
- c. Exhibit enzymatic activity.
- d. Serve structural roles in the cell.
- e. Monomeric.

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

- 1. The amino acid composition is found to be [ala, lys, phe, met, cys, plus some decomposition products].
- 2. The peptide has a molecular weight around 700 Da and absorbs at 280 nm.

3. Treatment with carboxypeptidase results in tryptophan and a peptide.
4. CNBr treatment yields a tetrapeptide and a dipeptide.
5. Trypsin digestion produces an amino acid and a pentapeptide with met on the amino end.
6. 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

11. Collagen is an example of a(n):

- a. enzyme.
- b. regulatory protein.
- c. transport protein.
- d. storage protein.
- e. structural protein.

12. The amide plane of the peptide backbone includes all the atoms EXCEPT:

- a. C α -carbon.
- b. amide nitrogen.
- c. side chain carbons.
- d. carbonyl carbon.
- e. none, all are included.

13. As a result of mutarotation, D-glucose exists in all of the following forms EXCEPT:

- a. L-glucopyranose.
- b. α -anomer.
- c. free aldehyde.
- d. α -anomer.
- e. all are true.

14. Which of the following disaccharides contains an α (1 \rightarrow 4) O-glycosidic bond?

- a. sucrose
- b. lactose
- c. maltose
- d. cellobiose
- e. cellulose

15. "Blood sugar" in hemolymph of insects is _____ represented as _____.

- a. trehalose; Glc α 4Glc
- b. glucose; Glc
- c. maltose; Glc α 4Glc
- d. lactose; Gal β 4Glc
- e. cellulose; Glc β 4Glc

16. Neither α -amylase or β -amylase can cleave the _____ bonds of amylopectin and _____ glucosidase is required to completely hydrolyze starch.

- a. α (1 \rightarrow 6)-; α (1 \rightarrow 6)-
- b. β (1 \rightarrow 6)-; β (1 \rightarrow 6)-
- c. α (1 \rightarrow 4)-; α (1 \rightarrow 4)-
- d. β (1 \rightarrow 4)-; β (1 \rightarrow 4)-
- e. none are true.

17. **Cartilage-matrix proteoglycan has all of the following properties EXCEPT:**

- a. responsible for the flexibility and resiliency of cartilage.
- b. has a hyaluronic acid binding domain.
- c. has reversible hydration-dehydration properties.
- d. contains both N-linked and O-linked oligosaccharides.
- e. is an integral transmembrane protein.

18. **When we say that biological membranes are asymmetric structures we mean that:**

- a. The lipids are not evenly distributed transversely in the membrane.
- b. The proteins are not evenly distributed over the surface of the membrane.
- c. Patches of cholesterol and other lipids occur on the surface of the membrane.
- d. Certain membrane proteins seem to prefer association with specific lipids.
- e. All are true

19. **The two major phospholipids on the outer leaflet of erythrocytes are:**

- a. phosphatidylcholine and phosphatidylethanolamine.
- b. phosphatidylcholine and sphingomyelin.
- c. phosphatidylethanolamine and sphingomyelin.
- d. phosphatidylserine and sphingomyelin.
- e. phosphatidylcholine and phosphatidylserine.

20. **Lipid bilayers differ from micelles in that micelles are:**

- a. self limiting structures.
- b. formed spontaneously.
- c. stable in aqueous solution.
- d. often transformed into vesicles.
- e. all are true.

21. **All of the following are characteristics of chain termination protocol EXCEPT:**

- a. A known sequence serves as a template in a polymerization reaction.
- b. Four parallel reactions are run, each containing the substrates for DNA polymerase.
- c. The chain is terminated where the dideoxynucleotide is incorporated.
- d. One dNTP is a radioactively labeled tracer to detect the products in the polymerization process.
- e. The dideoxynucleotide lacks 3'-OH and therefore can not serve as acceptors in nucleotide addition.

22. **DNA double helix structure is stabilized by all of the following EXCEPT:**

- a. sugar-phosphate backbones run in opposite directions.
- b. the two glycosidic bonds holding the bases are exactly across the helix.
- c. both internal and external hydrogen bonds are present.
- d. bases stack together through hydrophobic interactions and van der Waals forces.
- e. appropriate base pairing builds a polymer whose external dimensions are uniform.

23. **The hyperchromic shift that occurs when dsDNA is _____ is a(n) _____ in absorption at _____ nm.**

- a. methylated; increase; 220
- b. methylated; decrease; 260
- c. denatured; decrease; 260
- d. denatured; increase; 260
- e. melted; decrease; 280

24. **Urea and formamide are agents that denature dsDNA by**

- a. intercalating between base pairs and disrupting van der Waals interactions.
- b. forming ionic bonds with the backbone phosphates.
- c. competing effectively with the H-bonding between the base pairs.
- d. changing the pH to cause hydrolysis.
- e. none are true

25. The UV absorption decrease associated with ssDNAs reannealing plotted on a _____ will indicate that more _____ DNAs take longer to renature .

- a. cot curve; complex
- b. cat curve; double strand nature
- c. c/co curve; simple
- d. cot curve; simple
- e. cat curve; complex

26. All are correct statements comparing an intact 4 kb plasmid and a 4 kb fragment of *E. coli* chromosomal DNA. The plasmid has a 50% G+C content and the chromosomal DNA has a 55% G+C content **EXCEPT**:

- a. The T_m of the plasmid would be less than the T_m of the chromosomal DNA.
- b. The $cot_{1/2}$ value (time required to renature 50% of the DNA molecules) of the plasmid would be more than that of the chromosomal DNA.
- c. The plasmid DNA and chromosomal DNA would both show approximately a 30-40% increase in their absorption at 260 nm upon heating to 90°C.
- d. The plasmid DNA would contain more negative supercoiling than the chromosomal DNA fragments.
- e. All are true.

27. All are true for linking number **EXCEPT**:

- a. It is a basic parameter characterizing supercoiled DNA.
- b. $L = T + W$.
- c. It is the number of times that two strands are intertwined providing both strands remain covalently intact.
- d. $L = 40$ in a relaxed circular DNA duplex of 400 bp.
- e. All are true.

28. DNA sequences that are inverted repeats, or _____, have the potential to form a _____ structure known as a _____ if the normal _____ base pairing is replaced by _____ pairing.

- a. probes; secondary; cruciform; interstrand; intrastrand
- b. palindromes; tertiary; cruciform; interstrand; intrastrand
- c. cruciforms; secondary; palindrome; intrastrand; interstrand
- d. palindromes; tertiary; cruciform; intrastrand; interstrand
- e. none are true.

29. Carbon dioxide affects O_2 binding to Hb by:

- a. Hb competing with carbonic anhydride for CO_2 .
- b. directly binding to heme-Fe in the oxygen binding site.
- c. forming iron carbonate with the heme-iron.
- d. forming $H^+ + HCO_3^-$ where the H^+ is an antagonist to oxygen binding to Hb.
- e. forming HCO_3^- that combines with H^+ to increase CO_2 binding.

30. BPG shifts the oxygen saturation curve of Hb to the _____ because BPG binds to _____ making Hb an O_2 delivery system eminently suited for _____.

- a. right; deoxyHb; humans and other primates
- b. right; deoxyHb; cattle, sheep and goats
- c. left; oxyHb; cattle, sheep and goats
- d. left; oxyHb; humans and other primates
- e. none of the above

31. When O_2 binds to _____ in Hb, the _____ ion is drawn into the plane of the _____ causing a conformational change that is transmitted to _____ enhancing the _____ for additional O_2 binding.

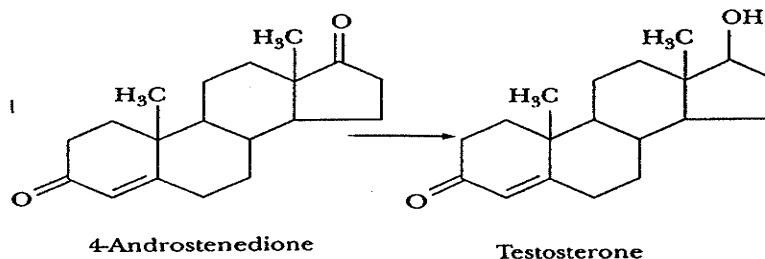
- a. porphyrin; Mg; globin; heme; planarity
- b. porphyrin; Fe; heme; globin; folding
- c. heme; Mg; globin; adjacent subunits; attraction
- d. heme; Fe; porphyrin; adjacent subunits; affinity

e. Fe; CO; porphyrin; myoglobin; affinity

32. The terpenes are all **EXCEPT**:

- a. made up of isoprene monomers.
- b. formed from two or more 2-methyl-1,3-butadiene molecules.
- c. components of wool wax.
- d. monomers units linked head to tail.
- e. all are true.

33. The reaction below is catalyzed by:



- a. desmolase.
- b. 17α -hydroxylase.
- c. $17,20$ -lyase.
- d. 17β -hydroxysteroid dehydrogenase.
- e. none, are true.

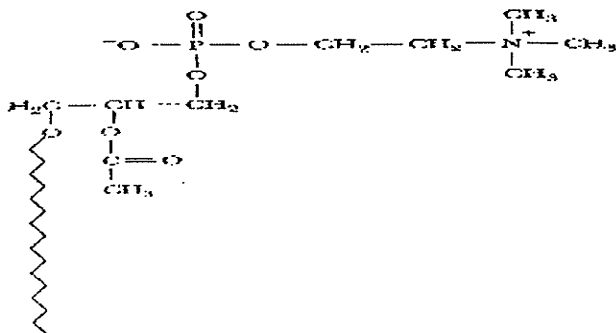
34. Alkali hydrolysis of triacylglycerols is called _____ and yields _____ and _____.

- a. triacylation; fatty acids; glycerol
- b. saponification; fatty alcohols; fatty acids
- c. triesteration; salts of fatty acids, fatty alcohols
- d. saponification; salts of fatty acids; glycerol
- e. none are true

35. Dietary essential fatty acids for humans include

- a. γ -linolenic and oleic acids.
- b. oleic and linoleic acids.
- c. palmitic and oleic acids.
- d. linoleic and γ -linolenic acids.
- e. all are true.

36. The structure is that of



- a. sphingomyelin.
- b. platelet activating factor (PAF).
- c. phosphatidylcholine.
- d. a cerebroside.
- e. phosphatidylethanolamine.

37. Glycosphingolipids consist of a _____ with one or more _____ residues in a _____ linkage at the 1-hydroxyl moiety.
- sugar; fatty acids; ester
 - ceramide; sugar; β -glycosidic
 - ceramide; fatty acid; amide
 - glycerol; fatty acids; ester
 - none are true
38. Although present in small amounts in most membranes, glycosphingolipids have a number of cellular functions **EXCEPT**:
- involvement in nerve impulse transmission.
 - water-repellant properties of animal skin.
 - tissue and organ specificity.
 - cell-cell recognition.
 - tissue immunity.
39. Alpha helices are stabilized primarily by:
- hydrogen bonds between the main chain peptide bond component atoms.
 - electrostatic interactions between R-groups.
 - hydrophobic interactions between the α -carbons of the main chain.
 - hydrogen bonding between the R-groups.
 - hydrophobic interactions between R-groups and the solvent water.
40. A Ramachandran plot shows:
- the amino acid residues which have the greatest degree of rotational freedom.
 - the sterically allowed rotational angles between R groups and α -carbons in a peptide.
 - the sterically allowed rotational angles between C_α and the amide nitrogen (C_α -N) as well as between C_α and the amide carbonyl carbon (C_α -CO).
 - the sterically allowed rotational angles about the amide nitrogen (NH) and CO.
 - the amino acid residues that form α -helix, β -sheet, etc.
41. Tertiary structure is defined as:
- the sequence of amino acids.
 - the folding of a single polypeptide chain in three-dimensional space.
 - hydrogen bonding interactions between adjacent amino acid residues into helical or pleated segments.
 - the way in which separate folded monomeric protein subunits associate to form oligomeric proteins.
 - all are true.
42. Silk fibers consist of _____ proteins consisting of alternating _____ and _____ or _____ residues.
- fibroin; glycine; proline; leucine
 - α -keratin; alanine; glycine; serine
 - fibroin; glycine; alanine; threonine
 - β -keratin; cysteine; alanine; proline
 - fibroin; glycine; alanine; serine

43. The unique composition of collagen is accommodated in a structure called a(n):
- β -pleated sheet.
 - triple helix.
 - helix-turn-helix motif.
 - coiled coils.
 - all are true.
44. The correct sequence for homologous recombination steps is:
- ligation.
 - branch migration and strand exchange.
 - nicking.
 - EW or NS cleavage, resolution and re-ligation.
 - strand invasion.
- B, C, E, A, D
 - C, B, E, D, A
 - D, C, B, A, E
 - C, E, A, B, D
 - C, A, B, E, D
45. _____ promotes the formation of covalent bonds between _____ thymine residues in a DNA strand creating a _____ ring called a thymidine dimer.
- Visible light; adjacent; cyclohexyl
 - Visible light; nearby; cyclobutyl
 - UV light; adjacent; cyclobutyl
 - UV light; nearby; cyclohexyl
 - IR light; adjacent; cyclobutyl
46. Nitrous acid causes the oxidative deamination of cytosine producing uracil. What point mutation is the logical result?
- C-G to A-T, only
 - C-G to T-A, only
 - C-G to G-C, only
 - both a and b are correct
 - a, b and c are correct
47. In base-excision repair, the first enzyme in the sequence is _____ creating a(n) _____ site.
- DNA polymerase III; ligase binding
 - DNA glycosylase; apurinic or apyrimidinic
 - DNA polymerase I; apurinic or apyrimidinic
 - DNA ligase; polymerase III binding
 - AP endonuclease; ligase binding
48. The repair of cyclobutane pyrimidine dimers involves bacterial _____ and the cofactors _____ and _____.
- DNA methylase; S-adenosyl methionine; ATP
 - DNA carboxylase; CoA; CoQ
 - DNA polymerase I; flavin; TPP
 - photolyase; flavin; NADH
 - photolyase; flavin; pterin

49. Heat shock element (HSE) is a(n) _____ found in the _____ region of genes whose transcription is activated in response to _____.
- a. silencer; enhancer; cold
 - b. response element; promoter; elevated temperature
 - c. promoter; enhancer; elevated temperature
 - d. enhancer; response element; elevated temperature
 - e. silencer; promoter; cold
50. The mechanism by which _____ are removed and multiple _____ are spliced together to generate a continuous, translatable mRNA must be both _____ and _____.
- a. introns; exons; precise; complex
 - b. exons; introns; precise; complex
 - c. exons; introns; continuous; simple
 - d. introns; exons; continuous; simple
 - e. none are true