

國立臺灣海洋大學九十九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：食品科學系碩士班食科組、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、PART A

### (I) 簡答題：(5 point for each)

1. What different? Compare both biosynthesis and degradation of fatty acid.
2. How to define the fatty acid omega-oxidation?
3. Describe the hypothesis of chemiosmotic coupling for ATP synthesis.

### (II) 單選題：(2 point for each)

1. Which one of the following statements about fatty acid metabolism is NOT correct?
  - a. Ketone bodies are water-soluble, transportable acetyl units
  - b. Arachidonate is a 20:4 fatty acid that is precursor to several classes of short-lived hormones
  - c. Triacylglycerols are the highly concentrated form of chemical energy stored in adipose tissue
  - d. The first step of fatty acid biosynthesis is made exergonic by the decarboxylation of acetyl CoA
  - e. Fatty acids are usually ingested as triglycerides, which cannot be absorbed by the intestine
2. Acetyl groups (e.g. for lipid biosynthesis) are transported out of the mitochondria indirectly using
  - a. acetyl carnitine
  - b. malate
  - c. acetyl CoA
  - d. acetyl phosphate
  - e. citrate
3. Body fat is a major storage form of energy because it:
  - a. yields about 25 kJ/g (6 cal/g) of energy
  - b. yields about 17 kJ/g (4 cal/g) of energy
  - c. aggregates in a highly anhydrous form (without additional water weight)
  - d. is highly hydrated and easy to metabolize
  - e. has low insulation properties
4. Bile salts are important in the initial digestion of triacylglycerols in the intestine because they:
  - a. are coenzymes for pancreatic lipase.
  - b. permit greater permeability of the triacylglycerols through the intestinal membrane
  - c. emulsify the triacylglycerol globules to produce greater surface area which will increase the activity of the lipase
  - d. activate the cleavage at the C-2 position
  - e. convert the inactive lipase into the active form
5. Which one of the following is NOT a membrane-associated process?
  - a. active transport of glucose into intestinal absorptive cells
  - b. growth hormone binding to its specific receptors
  - c. oxidative phosphorylation
  - d. synthesis of secreted proteins
  - e. synthesis of stearic acid

## II · PART B

### (I) Multiple choices: (單選, 2 points for each)

- In plants and cyanobacteria, Photosystem II \_\_\_\_\_, and Photosystem I \_\_\_\_\_.
  - oxidizes  $H_2O$ , reduces  $NADP^+$ .
  - oxidizes  $H_2O$ , reduces FAD.
  - oxidizes  $O_2$ , reduces FAD.
  - oxidizes  $O_2$ , reduces  $NADP^+$ .
  - oxidizes  $H_2O$ , reduces  $NAD^+$ .
- Which statement about carotenoids is wrong?
  - $\beta$ -Carotene helps absorb light for photosynthesis.
  - Carotenoids are part of the prosthetic ring structure of chlorophylls.
  - $\beta$ -Carotene is one type of carotenoid.
  - The fall colors observed in leaves are due, in part, to carotenoids.
  - All of the above statements are true.
- In most organisms, replication proceeds in a \_\_\_\_\_ manner from the \_\_\_\_\_.
  - bidirectional, lagging strand.
  - bidirectional, theta site.
  - unidirectional, chromosome ends.
  - bidirectional, replication origin.
  - unidirectional, replication origin.
- RNA–DNA hybrids are observed \_\_\_\_\_, and they are structurally similar to \_\_\_\_\_.
  - during viral replication, B-DNA.
  - during transcription, B-DNA.
  - during replication, A-DNA.
  - during transcription, Z-DNA.
  - in bacteria only, A-DNA.
- Splicing is mediated by \_\_\_\_\_ in the \_\_\_\_\_.
  - smURFs, spliceosome.
  - TBP, TATA box.
  - promoters, upstream region.
  - TAFs, nucleus.
  - snRNPs, spliceosome.
- In eukaryotes, the three RNA polymerases recognize:
  - a promoter sequence known as the Rho factor.
  - different types of promoters.
  - a promoter sequence known as the sigma factor.
  - a single promoter sequence.
  - none of the above.
- Which of the following is associated with the initiation of translation in eukaryotes?
  - eIF4E (cap-binding protein).
  - initiation factors IF-1, IF-2, and IF-3.
  - Shine–Dalgarno sequence.
  - base pairing between the mRNA and 16S rRNA.
  - a formylated Met-tRNA.

8. How does the transcriptional machinery gain access to the nucleosome-sequestered DNA?
- The transcription proteins have higher affinity for DNA and push the histones away from binding sites.
  - Methylation of DNA prevents histone binding.
  - Chromatin-remodeling complexes allow sections of DNA to be transiently exposed to transcription factors.
  - a and b.
  - a, b, and c.
9. Which of the following statements about microtubules is wrong?
- Microtubules are hollow structures.
  - Microtubules are used to form structures such as cilia and flagella.
  - Microtubules grow by the addition of dimers.
  - The structural unit is tubulin, a dimeric protein containing  $\alpha$ -tubulin and  $\beta$ -tubulin.
  - Microtubules can serve as membrane channels for small anions.
10. Which of the following events are necessary for efficient expression of the *lac* operon?
- CAP must bind cAMP.
  - The *lac* repressor must bind inducer and dissociate from the operator site.
  - CAP and the repressor must simultaneously bind to RNAP.
  - a and b.
  - a, b, and c.

**(II) Fill in questions: ( 填空, 1 points for each )**

- In the \_\_\_\_\_ cycle,  $\text{CO}_2$  is "fixed" to generate carbohydrate molecules.
- Pol I synthesize new DNA with very high fidelity, due to its \_\_\_\_\_ capabilities.
- The term rRNA refers to \_\_\_\_\_ RNA.
- \_\_\_\_\_ is a mechanism of posttranscriptional RNA-dependent gene silencing.
- Programmed cell death is called \_\_\_\_\_.

**III、PART C**

單選(每題1分，共25題)

- The effects of \_\_\_\_\_ on the  $\Delta G^\circ$  of hydrolysis of ATP are much greater than the effects of \_\_\_\_\_ or \_\_\_\_\_ under physiological conditions.
  - pH, concentration, metal ions
  - metal ions, pH, concentration
  - temperature, concentration, pH
  - concentration, pH, metal ions
  - none of the above.
- All are true for the Second Law of Thermodynamics EXCEPT:
  - Systems tend to proceed from ordered states to disordered states.
  - The entropy of the system plus surroundings is unchanged by reversible processes
  - The entropy of the system plus surroundings increases for irreversible processes.
  - All naturally occurring processes proceed toward equilibrium.
  - None, all are true.
- Transamination of pyruvate with glutamate as amino donor gives:
  - alanine.
  - serine.
  - cysteine.
  - aspartate.
  - valine.

4. Amino acids biosynthesized from aspartate include all EXCEPT:
- asparagine.
  - threonine.
  - methionine.
  - lysine.
  - glutamate.
5. All of the following are true of the urea cycle EXCEPT:
- It helps in the excretion of excess nitrogen.
  - It is mainly confined to the liver.
  - It is linked to the citric acid cycle through fumarate.
  - Stimulation of carbamoyl-phosphate synthetase I (CPS-I) decreases the activity of the urea cycle.
  - It is completed by the regeneration of ornithine from arginine.
6. All of the following act in feedback inhibition of glutamine synthetase (GS) in prokaryotes EXCEPT:
- AMP.
  - glucosamine-6-phosphate.
  - histidine.
  - proline.
  - CTP.
7. Glutamate synthase (GOGAT) catalyzes the reaction \_\_\_\_\_ + \_\_\_\_\_ + \_\_\_\_\_  $\rightarrow$  2 glutamate + NADP<sup>+</sup>
- $\alpha$ -ketoglutarate; NADPH; glutamine
  - glutamate;  $\alpha$ -ketoglutarate; NADH
  - glutamyl-phosphate; glutamine; NADPH
  - N-acetylglutamate;  $\alpha$ -ketoglutarate; NADH
  - none are true
8. The involvement of ATP in the nitrogenase complex is because ATP is needed to:
- provide electrons.
  - phosphorylate the enzyme.
  - break the N<sub>2</sub> triple bond.
  - transfer electrons from ferredoxin.
  - all are true.
9. Regulation of metabolism by activation of the gene encoding a particular enzyme is called \_\_\_\_\_.
- covalent modification
  - repression
  - induction
  - allosteric activation
  - none of the above
10. Characteristics of glycogen phosphorylase include all EXCEPT:
- covalently linked pyridoxal phosphate.
  - an active site at the center of each of two identical subunits.
  - regulatory phosphorylation site on a Ser residue.
  - allosteric effector sites for ATP and glucose-6-phosphate.
  - all are true.

11. The correct sequence for the hormone-activated enzymatic cascade that leads to activation of glycogen phosphorylase is:
- Phosphorylation to active phosphorylase kinase
  - Activation of G-protein
  - Activation of adenylyl cyclase to produce cAMP
  - Phosphorylation of glycogen phosphorylase
  - cAMP activation of protein kinase A (PKA)
- A, B, C, D, E
  - B, C, E, A, D
  - C, B, A, D, E
  - B, D, E, A, C
  - B, E, A, D, C,
12. All are true for cAMP-dependent protein kinase EXCEPT:
- also known as PKA.
  - phosphorylase kinase is a substrate.
  - consists of a pair of catalytic subunits.
  - two regulatory subunits block catalytic activity without cAMP binding.
  - phosphorylates glycogen phosphorylase.
13. Regulation of metabolism by activation of the gene encoding a particular enzyme is called \_\_\_\_\_.
- covalent modification
  - repression
  - induction
  - allosteric activation
  - none of the above
14. Usually the quickest method of influencing an enzymatic activity is by:
- allosteric regulation.
  - covalent modification.
  - enzyme induction.
  - activation of a zymogen.
15. Aspartate proteases display a variety of substrate specificities, but normally they are most active in cleavage of peptide bonds:
- on the carboxyl side of the basic amino acids.
  - on the carboxyl side of aromatic amino acids.
  - on the carboxyl side of small, neutral residues.
  - between two hydrophobic amino acid residues.
  - none of the above.
16. The pH optimum of an enzyme is:
- always between pH 6-8.
  - nearly the same for all enzymes.
  - pretty broad over 6-8 pH units.
  - occurs when there is optimum secondary and tertiary structure in the active site of the enzyme.
  - all are true.
17. Carbohydrate characteristic chemical features include all EXCEPT:
- the potential to form multiple hydrogen bonds. -
  - the existence of one or more asymmetric centers.
  - the capacity to form polymeric structures.
  - the ability to exist in either linear or ring structures.
  - all are true.
18. Which of the following sugars is an aldopentose?
- galactose
  - ribulose
  - ribose
  - xylulose
  - mannose

19. The formation of cyclic structures in sugars with creation of an additional asymmetric center results from an alcohol reacting with a(n):
- secondary alcohol.
  - phosphate group.
  - thiol group.
  - aldehyde or ketone.
  - primary alcohol.
20. All of the following statements about cyclic sugars are true EXCEPT:
- The  $\alpha$ -anomer has the -OH of the anomeric carbon positioned on the opposite side of the sugar ring from the -CH<sub>2</sub>OH.
  - The five and six membered rings are more frequently observed due to stability.
  - In a chair conformation, the predominant form has the bulkiest substituents occupying axial positions.
  - The carbonyl carbon becomes a chiral center.
  - They can be formed by the intramolecular reactions to hemiacetals or hemiketals.
21. Individuals with uncontrolled diabetes mellitus may have \_\_\_\_\_ levels of blood \_\_\_\_\_ so they test their blood for \_\_\_\_\_.
- elevated; fructose; gluconic acid
  - depressed; glucose; oxidizing sugars
  - elevated; glucose; fructose
  - depressed; gluconic acid; reducing sugars
  - elevated; glucose; reducing sugars
22. Which of the following explains why the disaccharide sucrose is not a reducing sugar?
- the primary hydroxyl groups are oxidized to carboxylic acids
  - both anomeric carbons are involved in formation of the glycosidic bond
  - the glycosidic bond is in the  $\alpha$  configuration
  - it is composed of a furanose and a pyranose
  - none of the above
23. \_\_\_\_\_ is an enzyme found in liver and muscle tissue used to catalyze the hydrolysis of glycogen to \_\_\_\_\_.
- (1 $\rightarrow$ 6)-Glucosidase; glucose-1-phosphate
  - Amylase; glucose-1-phosphate
  - Amylase; glucose
  - Glycogen maltase; maltose
  - Glycogen phosphorylase; glucose-1-phosphate
24. All of the following statements about the nature of glycogen are true EXCEPT:
- It is a polysaccharide used for storage.
  - It is a branched polymer of linked glucose residues.
  - It has all non-reducing ends.
  - The highly branched structure allows the rapid mobilization of glucose during metabolic need.
  - It is found primarily in the liver and skeletal muscles.
25. Amino acid side chains capable of forming hydrogen bonds are usually located on the protein \_\_\_\_\_ and form hydrogen bonds primarily with the \_\_\_\_\_.
- surface, water solvent
  - interior, water solvent
  - surface, other amino acid side chains
  - interior, other amino acid side chains
  - all are true

#### IV - PART D

(I) Proteins and nucleic acids are informational macromolecules. What are the two minimal criteria for a linear informational polymer? (4%)

(II) What are telomeres? What is telomere theory of aging? Why tumor cells are immortal? (5%)

(III) Multiple choice questions (only one answer is correct for each question!): total 16%, each 2%.

1. Which is a six-membered heterocyclic aromatic ring?
  - a. pyrimidine
  - b. purine
  - c. anose
  - d. sugar portion of DNA
  - e. ribonucleotide
  
2. The  $T_m$  for the melting the DNA double helix is:
  - a. The temperature at which the helix starts to open.
  - b. The temperature at which the helix is completely open.
  - c. The midpoint of the range over which the helix denatures.
  - d. The energy needed to melt the DNA.
  
3. What is the nucleotide sequence of the DNA strand that is complementary to 5'-ATCGCAACTGTCACTA-3'?
  - a. 5'-TAGCGTTGACAGTGAT-3'
  - b. 5'-UAGUGACAGUUGCGAU-3'
  - c. 5'-TAGCGTTGACAGTGAT-3'
  - d. 5'-TAGTGACAGTTGCGAT-3'
  - e. 5'-ATCACTGTCAACGCTA-3'
  
4. All are true for plasmids useful as cloning vectors EXCEPT:
  - a. a replicator
  - b. a selectable marker
  - c. a ribosome binding site
  - d. a cloning site
  - e. All are true.
  
5. 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.
  
6. Shuttle vectors have the property that they:
  - a. contain promoters for the expression of the gene.
  - b. have origins of replication for two different cell types, usually bacteria and yeast.
  - c. are capable of incorporating very large DNA fragments.
  - d. contain more than one antibiotic resistant gene.
  - e. none of the above

7. The net charge on nucleotide monophosphates is:

- a. +1
- b. 0
- c. -1
- d. -2
- e. -3

8. Which of the following is the appropriate source of the DNA polymerase included in the PCR reaction mixture?

- a. *E. coli*
- b. bacteriophage T4
- c. *Thermus aquaticus*
- d. *Drosophila melanogaster*
- e. Human