國立臺灣海洋大學113學年度碩士班考試入學招生考試試題

考試科目：生物化學

學系組名稱：食品科學系碩士班食品科學組、食品科學系碩士班生物科技組

1.答案以橫式由左至右書寫在**答案卷**上。2.請依題號順序，並標示題號作答。

第一部份

1. Single choice question. (20%, 2% each)

(1) Which of the following amino acid residues which does not have a preferred location at α-helix?

(a) Glu

(b) Thr

(c) Ala

(d) Leu

(e) None of the above

(2) Which of the followings regarding secondary active transporters are not true?

(a) Triggered by ATP hydrolysis

(b) Located on cell membranes

(c) They are proteins molecules

(d) Involved in nutrient and ions transport

(e) None of the above

(3) How is the extent of supercoiling measured?

(a) $Lk - Lk_0$

(b) $Lk - Lk_0 + Wr$

(c) $Lk_0 - Lk$

(d) $Lk_0 - Lk + Wr$

(e) $Lk + Lk_0 + Wr$

(4) Which of the following nucleobases in the nucleic acid DNA specifically interact with proteins the most?

(a) Adenine

(b) Thymine

(c) Guanine

(d) Cytosine

(e) Uracil

(5) How many possible reading frames are there in one mRNA?

(a) 1

(b) 2

(c) 3

(d) 4

(e) 6

(6) Chromosome replication

(a) is catalyzed by RNA polymerase

(b) needs no RNA primers

(c) is semiconservative

(d) begins at promoter

(e) is mostly template-independent

(7) Which of the followings regarding cAMP is not True?

(a) An intracellular second messenger molecule

(b) To activate catabolite activator protein

(c) cAMP is low when glucose is the carbon source

(d) An important energy source in cells

(e) Involved in gene regulation in response to hormones and nutrients

(8) Which of the followings regarding α-helix is not true?

(a) Most common secondary structure in proteins

(b) Mostly left-handed in proteins

(c) Consist of mostly L-amino acids

(d) 3.6 residues per turn

(e) Stabilized by hydrogen bonds

(9) Which of the followings regarding B-form DNA is not true?

(a) Double stranded

(b) Antiparallel

(c) Right-handed helix

(d) Stabilized by hydrogen bonds

(e) Approximate 22 nm wide for the major groove

(10) DNA gyrase in DNA replication can

(a) melt double helical DNA

(b) anneal single stranded DNA

(c) introduce positive supercoils at the expense of ATP hydrolysis.

(d) introduce negative supercoils at the expense of ATP hydrolysis.

(e) do none of the above

2. Assay questions (25%)

(a) Please define heterologous expression, explain its application in food, and provide an example. (5%)

(b) Please describe the *trp* operon in *E. coli* in terms of its physiological role and regulation mechanisms, such as the repressor protein and attenuation. (5%)

(c) Please explain the helix-turn-helix motif in proteins, including its structure, function, and potential interaction sites. (5%)

(d) Provide the Michaelis-Menten equation and define each term within it. (5%)

(e) Please define alternative splicing in eukaryotes, discussing its physiological role, mechanism, catalytic enzymes, and resulting products. (5%)

3. Please translate the following paragraph into Mandarin. (5%)

A fatty acid is composed of a long hydrocarbon chain (“tail”) and a terminal carboxyl group (or “head”). The carboxyl group is normally ionized under physiological conditions. Fatty acids typically are esterified to glycerol or other backbone structures. Most of the fatty acids found in nature have an even number of carbon atoms (usually 14 to 24). Fatty acids are either saturated or unsaturated (with one or more double bonds in the hydrocarbon chain). If a fatty acid has a single double bond, it is said to be monounsaturated, and if it has more than one, polyunsaturated.

第二部份

I. Assay questions (20%, 10% each)

1. What is reciprocal regulation of gluconeogenesis and glycolysis ?
2. Please explain how covalent modification and allosteric regulation control the activity of glycogen phosphorylase.

II. Paper reading (20%)

1. Please translate the following research abstract into Mandarin. **(15%)**

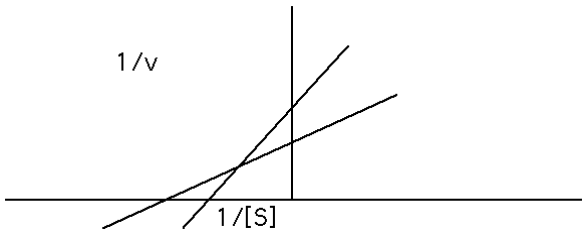
   The interplay between liver and bone metabolism remains largely uncharacterized. Here, we uncover a mechanism of liver-bone crosstalk regulated by hepatocyte SIRT2. We demonstrate that hepatocyte SIRT2 expression is increased in aged mice and elderly humans. Liver-specific SIRT2 deficiency inhibits osteoclastogenesis and alleviates bone loss in mouse models of osteoporosis. We identify leucine-rich α-2-glycoprotein 1 (LRG1) as a functional cargo in hepatocyte-derived small extracellular vesicles (sEVs). In SIRT2-deficient hepatocytes, LRG1 levels in sEVs are upregulated, leading to increased transfer of LRG1 to bone-marrow-derived monocytes (BMDMs), and in turn, to inhibition of osteoclast differentiation via reduced nuclear translocation of NF-κB p65. Treatment with sEVs carrying high levels of LRG1 inhibits osteoclast differentiation in human BMDMs and in mice with osteoporosis, resulting in attenuated bone loss in mice. Furthermore, the plasma level of sEVs carrying LRG1 is positively correlated with bone mineral density in humans. Thus, drugs targeting hepatocyte-osteoclast communication may constitute a promising therapeutic strategy for primary osteoporosis.

2. Please draft the title of above-mentioned abstract in English or Mandarin. **(5%)**

III. Single choice questions. (10%, 2% each)

1. Glutamic acid has pKa values of 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

2. Which of the following mutations would probably be least likely to impact the function of the protein?
   (a) Lys to Ser
   (b) Ala to Asp
   (c) His to Pro
   (d) Val to Ile
   (e) Phe to Tyr
3. Which of the following proteins does not have quaternary structure?
   (a) immunoglobulins
   (b) insulin
   (c) glycogen phosphorylase
   (d) alcohol dehydrogenase
   (e) myoglobin
4. ____ is an enzyme found in liver and muscle tissue used to catalyze the phosphorolysis of glycogen to ____.
   (a) Glycogen maltase; maltose
   (b) Glycogen phosphorylase; glucose-1-phosphate
   (c) β-(1→6)-Glucosidase; glucose-1-phosphate
   (d) α-Amylase; glucose-1-phosphate
   (e) β-Amylase; glucose
5. Identify the type of reaction that would give the following graph:



   (a) competitively inhibited reaction.
   (b) single displacement bisubstrate reaction.
   (c) mixed noncompetitively inhibited reaction.
   (d) double displacement bisubstrate reaction.
   (e) pure noncompetitively inhibited reaction.