

國立彰化師範大學101學年度碩士班招生考試試題

系所：生物技術研究所

科目：生物化學

☆☆請在答案卷上作答☆☆

共5頁，第1頁

I. Multiple choices. Please choose the best answer for each question. (30%)

- Two amino acids of the standard 20 contain sulfur atoms. They are:
(A) cysteine and serine. (B) cysteine and threonine.
(C) methionine and cysteine. (D) methionine and serine.
- For amino acids with neutral R groups, at any pH below the pI of the amino acid, the population of amino acids in solution will have:
(A) a net negative charge. (B) a net positive charge.
(C) no charged groups. (D) no net charge.
- The formation of a peptide bond between two amino acids is an example of a(n) _____ reaction.
(A) cleavage (B) condensation (C) group transfer (D) isomerization
- An allosteric interaction between a ligand and a protein is one in which:
(A) binding of a molecule to a binding site affects binding of additional molecules to the same site.
(B) binding of a molecule to a binding site affects binding properties of another site on the protein.
(C) binding of the ligand to the protein is covalent.
(D) multiple molecules of the same ligand can bind to the same binding site.
- The fundamental cause of sickle cell disease is a change in the structure of:
(A) blood. (B) capillaries. (C) hemoglobin. (D) red cells.
- One of the enzymes involved in glycolysis, aldolase, requires Zn^{2+} for catalysis. Under conditions of zinc deficiency, when the enzyme may lack zinc, it would be referred to as the:
(A) apoenzyme. (B) coenzyme. (C) holoenzyme. (D) prosthetic group.
- D-Glucose is called a reducing sugar because it undergoes an oxidation-reduction reaction at the anomeric carbon. One of the products of this reaction is:
(A) D-galactose. (B) D-gluconate. (C) D-glucuronate. (D) D-ribose.
- Which of the following is a dominant feature of the outer membrane of the cell wall of gram-negative bacteria?
(A) Amylose (B) Cellulose (C) Glycoproteins (D) Lipopolysaccharides
- Which of the following statements about membrane lipids is true?
(A) Glycerophospholipids are found only in the membranes of plant cells.
(B) Glycerophospholipids contain fatty acids linked to glycerol through amide bonds.
(C) Lecithin (phosphatidylcholine), which is used as an emulsifier in margarine and chocolate, is a sphingolipid.
(D) Some sphingolipids include oligosaccharides in their structure.
- An example of a glycerophospholipid that is involved in cell signaling is:
(A) arachidonic acid. (B) ceramide. (C) phosphatidylinositol. (D) testosterone.

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共5頁，第2頁

11. Enzymes differ from other catalysts in that only enzymes:
 - (A) are not consumed in the reaction.
 - (B) display specificity toward a single reactant.
 - (C) fail to influence the equilibrium point of the reaction.
 - (D) form an activated complex with the reactants.
12. Proteins often have regions that show specific, coherent patterns of folding or function. These regions are called:
 - (A) domains. (B) oligomers. (C) peptides. (D) sites.
13. Hormone-activated phospholipase C can convert phosphatidylinositol 4,5-bisphosphate to:
 - (A) diacylglycerol + inositol triphosphate. (B) diacylglycerol + inositol + phosphate.
 - (C) glycerol + inositol + phosphate. (D) glycerol + phosphoserine.
14. Glycogen is converted to monosaccharide units by:
 - (A) glucokinase. (B) glucose-6-phosphatase.
 - (C) glycogen phosphorylase. (D) glycogen synthase.
15. During seed germination, the glyoxylate pathway is important to plants because it enables them to:
 - (A) carry out the net synthesis of glucose from acetyl-CoA.
 - (B) form acetyl-CoA from malate.
 - (C) get rid of isocitrate formed from the aconitase reaction.
 - (D) obtain glyoxylate for cholesterol biosynthesis.

II. 下列三段英文敘述取自三篇生化相關的研究論文，請仔細閱讀之後，依照每一段的內容回答五個問題，問題均為單選，答錯不倒扣。(30%)

Lignins are complex racemic aromatic heteropolymers derived mainly from three hydroxycinnamyl alcohol monomers differing in their degree of methoxylation, *p*-coumaryl**M1H**, coniferyl**M1G**, and sinapyl**M1S** alcohols. These monolignols produce, respectively, *p*-hydroxyphenyl **H**, guaiacyl **G**, and syringyl **S** phenylpropanoid units when incorporated into the lignin polymer. The amount and composition of lignins vary among taxa, cell types, and individual cell wall layers and are influenced by developmental and environmental cues. Although exceptions exist, dicotyledonous angiosperm (hardwood) lignins consist principally of **G** and **S** units and traces of **H** units, whereas gymnosperm (softwood) lignins are composed mostly of **G** units with low levels of **H** units. Lignins from grasses (monocots) incorporate **G** and **S** units at comparable levels, and more **H** units than dicots. **H** units, derived from the incorporation of the monolignol *p*-coumaryl alcohol **M1H** into lignins, should not be confused with *p*-coumarate esters **Y3**, which appear as pendant groups acylating grass lignins—this confusion (and the derivation of identical products using degradative methods such as nitrobenzene oxidation) has led to overestimation of **H** levels in the past.

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共5頁，第3頁

1. 下列何者是lignin分子中

-hydroxyphenyl unit的生合成前驅物？
(A) *p*-coumaryl alcohol (B) coniferyl alcohol (C) sinapyl alcohol
(D) syringyl unit (E) *p*-coumarate esters
2. Lignin的組成分會因為taxa, cell types, individual cell wall layers的差別而有不同，同時會受developmental與environmental cues的影響，本文中描述的差異主要為哪一項因素的影響？
(A) taxa (B) cell types (C) cell wall layers (D) developmental cues (E) environmental cues
3. 使用nitrobenzene oxidation方法分析lignin組成分時，容易高估下列哪一項組成分的含量？
(A) *p*-hydroxyphenyl unit (B) guaiacyl unit (C) syringyl unit (D) sinapyl unit
(E) *p*-coumarate esters
4. Softwood lignin中含有最多的
(A) *p*-hydroxyphenyl unit (B) guaiacyl unit (C) syringyl unit
(D) sinapyl unit (E) *p*-coumarate esters
5. Coniferyl alcohol與sinapyl alcohol分子結構上主要的差異在於下列哪一種官能基數量上的差異？
(A) CH₃- (B) -CH₂- (C) -COOH (D) CH₃O- (E) -OH

cis-Unsaturated fatty acids (UFAs) have crucial roles in membrane biology and signalling processes in organisms ranging from bacteria to humans. The relative UFA content of cellular phospholipids exerts a major influence on the physical properties of most biological membranes. UFAs have a much lower transition temperature than saturated fatty acids because the steric hindrance imparted by the rigid kink of the *cis*-double bond results in much poorer packing of the acyl chains. Thus, UFAs are key molecules in the regulation of cellular membrane fluidity. In addition to their structural role, UFAs have recently been recognized as signalling molecules involved in several essential cellular processes, such as cell differentiation and DNA replication (for recent reviews see Heird and Lapillonne, 2005; Mansilla and de Mendoza, 2005). Alterations in UFA biosynthesis have been implicated in various disease states, including cardiovascular disease, obesity, non-insulin dependent diabetes mellitus, hypertension, neurological diseases and cancer (Brenner, 2003; Nakamura and Nara, 2004; Sampath and Ntambi, 2005; Thijssen and Mensink, 2005). There are two major mechanisms by which living organisms synthesize UFAs: mostly of them use an oxygen-dependent fatty acid desaturation pathway, whereas many prokaryotes, including *Escherichia coli*, synthesize UFAs anaerobically (Mansilla *et al.*, 2004). The fatty acyl desaturases, which introduce double bonds into fatty acyl chains, encompass a family of enzymes, representatives of which are found in all eukaryotes (Tocher *et al.*, 1998; Pereira *et al.*, 2003; Sperling *et al.*, 2003), as well as some prokaryotes such as cyanobacteria, bacilli, mycobacteria and pseudomonads (Mansilla and de Mendoza, 2005; Cronan, 2006; Zhu *et al.*, 2006). The reaction catalysed by these enzymes is an oxygen dependent desaturation of the full-length fatty acid chain, either as an acyl-thioester or as a phospholipid fatty acid moiety, and requires a specific electron transport chain.

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共5頁，第4頁

6. 下列哪一種生物細胞不產生fatty acyl desaturase？
(A)人類細胞 (B)豆科植物細胞 (C)大腸桿菌細胞 (D)藍綠菌細胞 (E)酵母菌細胞
7. fatty acyl desaturase可以使saturated fatty acids產生下列哪一種改變？
(A)支鍊變長 (B)氫原子數目增加 (C)碳原子數增加 (D)雙鍵數增加 (E)-OH基增加
8. 文中引用Mansilla and de Mendoza, 2005這一篇報告，其內容最可能與下列哪一個議題有關？
(A)大腸桿菌合成UFAs的代謝途徑 (B)人類細胞合成UFAs的代謝途徑
(C)UFAs與人類疾病的關係 (D)UFAs可以作為訊息傳遞分子
(E) fatty acyl desaturases的遺傳與調控機制
9. 下列何者可以作為fatty acyl desaturases作用的受質(substrates)？
(A)三酸甘油酯 (B)長鏈飽和脂肪酸的鹽類 (C)長鏈不飽和脂肪酸的鹽類
(D)類固醇 (E)磷脂質
10. 依照本文敘述，UFAs與下列哪一種疾病最有關聯？
(A)心血管疾病 (B)自體免疫性疾病 (C)消化道潰瘍 (D)細菌性傳染病
(E)病毒性肝炎與肝硬化

A captivating facet of carbohydrates and glycoconjugates is their exceptional structural and functional diversity, which requires a comparable multiplicity of the glycosyltransferases (GTs) and glycoside hydrolases (GHs) responsible for their biosynthesis and selective cleavage. To cope with this multiplicity, a classification of GHs into families based on amino acid similarities was introduced a decade ago and is updated regularly. In contrast to the IUB-MB enzyme nomenclature, this classification scheme was designed to integrate both structural and mechanistic features of these enzymes. Strikingly, the system based on amino acid sequence similarities (hence also reflecting similar structural features) often grouped enzymes with different substrate specificity in a single 'polyspecific' family. This classification system has since been extended to GTs. Over the years, the number of families of GHs and GTs has grown steadily and currently there are 85 and 52 families, respectively (these families are available on the continuously updated CAZy web server at <http://afmb.cnrs-mrs.fr/~pedro/CAZY/db.html>). Because the structures of proteins are better conserved than their sequences, the grouping of several families in 'clans' or superfamilies has been introduced. In addition to the multiplicity of their families, GHs and GTs also frequently display a modular structure in which the catalytic module carries one or several ancillary modules that are often but not always carbohydrate binding. In the genomic era, this modularity is of particular importance for correct open reading frame (ORF) annotation and functional prediction, whereas in structural biology, it can be a major hurdle for crystallization.

11. 一個GH酶的'polyspecific family' I.是IUB-MB enzyme命名法中最常見的單位， II.包含受質專一性不同的GH酶， III.是因胺基酸序列相似而被歸為一類的GH酶。以上述敘述中正確者為
(A)只有I (B)只有III (C)只有I和II (D)只有II和III (E) I、II和III

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共5頁，第5頁

12. GTs與GHs對carbohydrates的作用為
- (A) GTs為carbohydrates的分解酶，GHs為carbohydrates的合成酶
 - (B) GTs為carbohydrates的合成酶，GHs為carbohydrates的分解酶
 - (C) GTs與GHs均為carbohydrates的分解酶
 - (D) GTs與GHs均為carbohydrates的合成酶
 - (E) GTs與GHs均同時為carbohydrates的分解與合成酶
13. 將GH酶families合併成為一個clan，是依照這一些酶在下列哪一種性質上的相似性？
- (A) mechanistic features (B) structural features (C) substrate specificity
 - (D) amino acid sequences (E) modularity
14. Modularity是指一個酶分子有多個modules，下列哪一種module是每一個GH酶都具有的？
- (A) catalytic module (B) carbohydrate-binding module (C) crystallization module
 - (D) cleavage module (E) genomic module
15. CAZy web server網站中
- (A)只收錄GT酶的資料 (B)只收錄GH酶的資料 (C)將GT與GH視為同一類酶
 - (D)同時收錄GT與GH酶的資料 (E)使用的分類方法依照IUB-MB enzyme nomenclature的規範

III. 詳答題，請條例式及畫圖回答尤佳。(40%)

1. 市售飲料常以果糖作為甜味劑，請以果糖的結構功能在生化角色及代謝調控來說明果糖對於人體是好的甜味劑嗎？為何廠商要加此成分？
2. 目前政府推行食品必須加註反式脂肪的含量，請以反式脂肪的結構功能在生化角色及代謝調控來說明反式脂肪對於人體的害處及為何廠商要加此成分。
3. 近年來出現標榜含酵素的食品，請以酵素的結構功能在生化角色及代謝調控來說明這些市售酵素對於人體真的可以達到功效嗎？
4. 最近瘦肉精事件廣為討論，請說明何謂瘦肉精及其在生化角色及代謝調控的作用機制。