國立臺灣海洋大學　108 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：生命科學暨生物科技學系碩士班甲組(生科組)

1. 答案以橫式由左至右書寫。2.請依題號順序作答。

I. 單選題，每題 2.5 分 (25%)

1. Individuals with uncontrolled diabetes mellitus may have _____ levels of blood _____ so they test their blood for _____.
   a. elevated; fructose; gluconic acid　b. depressed; glucose; oxidizing sugars
   c. elevated; glucose; fructose　d. depressed; gluconic acid; reducing sugars
   e. elevated; glucose; reducing sugars

2. Carbohydrate characteristic chemical features include all **EXCEPT:**
   a. the potential to form multiple hydrogen bonds.
   b. the existence of one or more asymmetric centers.
   c. the capacity to form polymeric structures.
   d. the ability to exist in either linear or ring structures.
   e. all are true

3. Proteoglycans are a group of macromolecules formed from:
   a. proteases and monosaccharides.　b. proteins and glycosaminoglycans.
   c. proteins and polysaccharides.　d. proteases and glycosaminoglycans.
   e. proteins and glycogen

4. Diets aimed at reducing coronary heart disease should be:
   a. low in trans-fatty acids and high in saturated fatty acids.
   b. high in trans-fatty acids and high in saturated fatty acids.
   c. high in trans-fatty acids and low in saturated fatty acids.
   d. low in trans-fatty acids and low in saturated fatty acids.
   e. low in trans-fatty acids and low in unsaturated fatty acids.

5. The primary storage form of lipid is _____ and it is normally stored in the _____.
   a. phospholipid; liver　b. cholesterol; muscles　c. monoacylglycerol; adipocytes　d. triacylglycerols; adipocytes　e. triacylglycerols; liver

6. Chylomicrons:

a. are formed in adipose tissue.

b. are primary energy sources for the brain.

c. transport dietary triacylglycerols through the bloodstream.

d. are formed in and secreted by the liver.

e. contain more phospholipid than triacylglycerol molecules.

7. Ketone bodies are synthesized in the:

a.cytosol of muscle. b. mitochondria of liver. c. endoplasmic reticulum of heart. d. plasma membrane of brain. e. none of the above.

8.The committed step in fatty acid biosynthesis, formation of malonyl-CoA, is catalyzed by:

a. fatty acid synthase. b. pyruvate carboxylase. c. propionate carboxylase.

d. acetyl-CoA carboxylase. e. ATP-citrate lyase.

9.The committed step in cholesterol biosynthesis is catalyzed by:

a. HMG-CoA synthase. b. mevalonate kinase. c. HMG-CoA reductase.

d. squalene monooxygenase. e. HMG-CoA lyase.

10. Which of the following has the fastest rate of transport?

a. Channel-mediated diffusion b. Facilitated diffusion c. Active transport

d. Facilitated diffusion and active transport are equally fast.

II. 配合題 (18%)

選項

(a) Competitive inhibition

(b) Non-competitive inhibition

(c) Un-competitive inhibition

(d) Allosteric inhibition

(e) Transition state inhibitor

請依照上述選項，找出下述題目最適合的答案 (每題三分)

(1) The inhibitor reduces the activity of the enzyme and binds equally well to the enzyme whether or not it has already bound the substrate

(2) Takes place when an enzyme inhibitor binds only to the complex formed between the enzyme and the substrate

(3) Chemical compounds with a chemical structure that resembles the transition state of a substrate

molecule in an enzyme-catalyzed chemical reaction

(4) The regulation of an enzyme by binding an effector molecule at a site other than the enzyme's active site

(5) binding of an inhibitor prevents binding of the substrate of the enzyme

(6) K_m of enzymes will not change in which condition?

III. 問答題 (32%)

(a) 弗朗西絲·漢密爾頓·阿諾德（英語：Frances Hamilton Arnold，1956 年 7 月 25 日生），美國化學工程師，專精領域為化學工程、生物工程學、生物化學。阿諾德於 2018 年獲得諾貝爾化學獎，是該獎第五位女性得主。

阿諾德率先使用「定向演化」來創造具有改進的和/或新功能的酵素蛋白質。所謂的定向演化策略涉及蛋白質基因的疊代輪次隨機突變以及篩選具有改進功能的蛋白質，重複這些步驟來取得功能更強大的酵素。其實在自然界的演化過程也是如此進行的，但是自然選擇只能作用於現有的序列變異（突變），並且通常在很長一段時間內發生。 阿諾德通過在蛋白質的基礎序列中引入突變來加速這一過程; 然後，她測試這些突變的影響。如果突變改善了蛋白質的功能，她可以繼續疊代過程以進一步優化它。 該策略具有廣泛的意義，因為它可用於設計用於各種應用的蛋白質。利用這樣的技術概念，除了酵素之外也可以設計新的代謝途徑，以及遺傳調節迴路，甚至是新的生物體。(以上題幹修改自維基百科)。

請問，阿諾德進行酵素的「定向演化」研究，會使用到的生化技術有哪些?請舉出三個。(7%)

(b) 全覆式雜交(whole mount in situ hybridization)是一種藉體外基因轉錄使某基因之 noncoding strand 產生 antisense mRNA 與細胞內部 sense mRNA 雜交以觀察生物體內特定基因 mRNA 表現位置與表現量之技術，如果有一待檢測之 sense mRNA 序列為 5’-AUG CGC UCG CCA AUA GCG UGA CUG-3’ ，請問(1) antisense mRNA 之序列為何? (2) antisense mRNA 其 coding strand DNA 之序列為何? (3) sense mRNA 之 template strand DNA 序列為何? (15%)

(c) UGA 在一般生物體內為轉譯停止密碼(translation stop codon)，表示 mRNA 如有此序列則無法產生氨基酸，但是在果蠅粒線體 mRNA 中卻可轉譯出 tryptophan 氨基酸，請先解釋為何 UGA 為轉譯停止密碼及由你(妳)對蛋白質轉譯作用之了解解釋產生此現象之可能原因。(10%)

IV. 解釋名詞: 請解釋下列名詞以及用途 (25%)

1. CRISPR-Cas9 系統
2. microRNA
3. degenerate primer (for PCR)：請舉例
4. epigenetics
5. proteomics