

# 國立彰化師範大學 102 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

☆☆請在答案紙上作答☆☆

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

- At the isoelectric pH of a tetrapeptide:
  - only the amino and carboxyl termini contribute charge.
  - the amino and carboxyl termini are not charged.
  - the total net charge is zero.
  - there are four ionic charges.
- For the study of a protein in detail, an effort is usually made to first:
  - conjugate the protein to a known molecule.
  - determine its amino acid composition.
  - determine its amino acid sequence.
  - purify the protein.
- In a mixture of the five proteins listed below, which should elute second in size-exclusion (gel-filtration) chromatography?

(A) cytochrome <i>c</i>	$M_r = 13,000$
(B) immunoglobulin G	$M_r = 145,000$
(C) ribonuclease A	$M_r = 13,700$
(D) RNA polymerase	$M_r = 450,000$
- The term *specific activity* differs from the term *activity* in that specific activity:
  - is measured only under optimal conditions.
  - is the activity (enzyme units) in a milligram of protein.
  - is the activity (enzyme units) of a specific protein.
  - refers only to a purified protein.
- In the alpha-helix the hydrogen bonds:
  - are roughly parallel to the axis of the helix.
  - are roughly perpendicular to the axis of the helix.
  - occur mainly between electronegative atoms of the R groups.
  - occur only between some of the amino acids of the helix.

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6. 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.
7. An individual molecular structure within an antigen to which an individual antibody binds is as a(n):
- (A) antigen.
  - (B) epitope.
  - (C) Fab region.
  - (D) Fc region
8. How is trypsinogen converted to trypsin?
- (A) A protein kinase-catalyzed phosphorylation converts trypsinogen to trypsin.
  - (B) An increase in  $\text{Ca}^{2+}$  concentration promotes the conversion.
  - (C) Proteolysis of trypsinogen forms trypsin.
  - (D) Trypsinogen dimers bind an allosteric modulator, cAMP, causing dissociation into active trypsin monomers.
9. Starch and glycogen are both polymers of:
- (A) Glucose 1-phosphate.
  - (B) sucrose.
  - (C) alpha-D-glucose.
  - (D) beta-D-glucose.
10. 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

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11. In a double-stranded nucleic acid, cytosine typically base-pairs with:
  - (A) adenosine.
  - (B) guanine.
  - (C) inosine.
  - (D) thymine.
  
12. Current estimates indicate that humans have about \_\_\_\_\_ genes.
  - (A) 3,000
  - (B) 10,000
  - (C) 30,000
  - (D) 100,000
  
13. Which of the following is *not* an intermediate of the citric acid cycle?
  - (A) Acetyl-CoA
  - (B) Citrate
  - (C) Oxaloacetate
  - (D) Succinyl-CoA
  
14. The human genetic disease phenylketonuria (PKU) can result from:
  - (A) deficiency of protein in the diet.
  - (B) inability to catabolize ketone bodies.
  - (C) inability to convert phenylalanine to tyrosine.
  - (D) inability to synthesize phenylalanine.
  
15. Glutathione is a(n):
  - (A) isomer of oxidized glutamic acid.
  - (B) methyl-group donor in many biosynthetic pathways.
  - (C) product of glutamate and methionine.
  - (D) tripeptide of glycine, glutamate, and cysteine.

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## II. Please choose the best answer for each question. (30%)

1. There are two common (and equivalent) ways to describe molecular mass. The first is molecular weight, or relative molecular mass, denoted  $M_r$ . The molecular weight of a substance is defined as the ratio of the mass of a molecule of that substance to one-twelfth the mass of carbon-12 ( $^{12}\text{C}$ ). Since  $M_r$  is a ratio, it is dimensionless—it has no associated units. The second is molecular mass, denoted  $m$ .  
This is simply the mass of one molecule, or the molar mass divided by Avogadro's number. The molecular mass,  $m$ , is expressed in daltons (abbreviated Da). One dalton is equivalent to one-twelfth the mass of carbon-12; a kilodalton (kDa) is 1,000 daltons; a megadalton (MDa) is 1 million daltons. 由前文敘述可知， $M_r$  的單位為  
(A)  $^{12}\text{C}$  (B) daltons (C) kDa (D) MDa (E) 無單位
2. Oxidation of the carbonyl (aldehyde) carbon of glucose to the carboxyl level produces gluconic acid; other aldoses yield other aldonic acids. Oxidation of the carbon at the other end of the carbon chain—C-6 of glucose, galactose, or mannose—forms the corresponding uronic acid: glucuronic, galacturonic, or mannuronic acid. 由前文敘述可知，下列哪一個化合物沒有醛基？  
(A) glucose (B) gluconic acid (C) galactose (D) glucuronic acid (E) mannuronic acid
3. Glycogen synthase cannot make the ( 1→6) bonds found at the branch points of glycogen; these are formed by the glycogen-branching enzyme, also called amylo (1→4) to (1→6) transglycosylase or glycosyl-(4→6)-transferase. 由前文敘述可知，glycosyl-(4→6)-transferase 的功能為  
(A) 連接澱粉的主鏈 (B) 連接澱粉的支鏈 (C) 連接肝醣的主鏈 (D) 連接肝醣的支鏈  
(E) 切除肝醣的支鏈
4. In CAM plants,  $\text{CO}_2$  is fixed into malate in the dark and stored in vacuoles until daylight, when the stomata are closed (minimizing water loss) and malate serves as a source of  $\text{CO}_2$  for rubisco. 由前文敘述可知，malate 的功能為  
(A) 加速光合作用 (B) 作為 rubisco 的受質 (C) 提高液泡的滲透壓 (D) 儲存碳原子  
(E) 減少水分損失

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5. Acetyl-CoA carboxylase has three functional regions: biotin carrier protein; biotin carboxylase, which activates  $\text{CO}_2$  by attaching it to a nitrogen in the biotin ring in an ATP-dependent reaction; and transcarboxylase, which transfers activated  $\text{CO}_2$  from biotin to acetyl-CoA, producing malonyl-CoA. 由前文可知，下列敘述何者正確？
- (A) Acetyl-CoA carboxylase 酵素可以合成 acetyl-CoA  
(B) Acetyl-CoA carboxylase 酵素可以分解 acetyl-CoA  
(C)  $\text{CO}_2$  是 Acetyl-CoA carboxylase 酵素的受質  
(D) biotin 是 Acetyl-CoA carboxylase 酵素的受質  
(E) CoA 是 Acetyl-CoA carboxylase 酵素的產物
6. 葡萄糖氧化的反應為  $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$   $\Delta G^0 = -2870 \text{ kJ/mol}$ ；  
ATP 水解的反應為  $\text{ATP} + \text{H}_2\text{O} \rightarrow \text{ADP} + \text{Pi}$   $\Delta G^0 = -30.7 \text{ kJ/mol}$ ；則呼吸作用總反應  
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 38 \text{ADP} + 38 \text{Pi} \rightarrow 38 \text{ATP} + 6\text{CO}_2 + 44\text{H}_2\text{O}$  的  $\Delta G^0$  最接近  
(A) -2000 kJ/mol (B) -1000 kJ/mol (C) -500 kJ/mol (D) 1000 kJ/mol (E) 2000 kJ/mol
7. 下列哪一種細菌能量代謝的途徑所需的酵素種類最少？  
(A)酒精發酵 (B)丙酸發酵 (C)混合酸發酵 (D)丁二醇發酵 (E)乳酸發酵
8. 酵素反應的速率與受質濃度的關係為  $v = \frac{v_{\max}S}{K_m + S}$ ，其中  $K_m$  反映酵素與受質間的親和性，數  
值越高酵素對受質的親和性越低， $K_m$  的單位為  
(A) mole/sec (B) /sec (C) M (D) /M (E) M/sec
9. 酵素 不會 改變一個生化反應的 I. 反應速率； II. 反應平衡狀態； III. 活化能 ( $\Delta G^\ddagger$ )；  
IV.  $\Delta G^0$   
(A) 只有 I (B) 只有 I (C) 只有 I 和 III (D) 只有 II 和 III (E) 只有 II 和 IV
10. 表 16-1 為心肌細胞糖解作用 10 個反應的催化酵素簡寫名稱、反應在標準狀態下的自由能差 ( $\Delta G^0$ )、與反應在細胞內的實際自由能差 ( $\Delta G$ )，由其中的數值可知，在正常細胞生理狀態下，哪一個反應最接近其化學平衡狀態？  
(A) 1 (B) 3 (C) 5 (D) 8 (E) 10

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TABLE 16-1. STANDARD FREE ENERGY CHANGES ( $\Delta G^{\circ}$ ), AND PHYSIOLOGICAL FREE ENERGY CHANGES ( $\Delta G$ ) IN HEART MUSCLE, OF THE REACTIONS OF GLYCOLYSIS<sup>a</sup>

Reaction	Enzyme	$\Delta G^{\circ}$ (kJ·mol <sup>-1</sup> )	$\Delta G$ (kJ·mol <sup>-1</sup> )
1	Hexokinase	-20.9	-27.2
2	PGI	+2.2	-1.4
3	PFK	-17.2	-25.9
4	Aldolase	+22.8	-5.9
5	TIM	+7.9	+4.4
6 + 7	GADPH + PGK	-16.7	-1.1
8	PGM	+4.7	-0.6
9	Enolase	-3.2	-2.4
10	PK	-23.0	-13.9

<sup>a</sup> Calculated from data in Newsholme, E.A., and Start, C., *Regulation in Metabolism*, p. 97, Wiley (1973).

### III. 詳答題，以條列式及畫圖回答尤佳。(40%)

1. 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的缺點？及為何市售產品要加此成分？
2. 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缺點？及為何市售產品要加此成分？
3. 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產品對於人體真的可以達到功效嗎？
4. 市售常見膠原蛋白產品，請就膠原蛋白的生化結構及其生理功能來說明這類產品拿來食用和塗抹真有其效果嗎？