

高雄醫學大學 109 學年度學士後醫學系招生考試試題

科目：生化概論

- I. 【單選題】每題 1 分，共計 30 分。答錯 1 題倒扣 0.25 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。
1~15 題為普通生物學，16~30 題為生化概論。
- (B) 16. Which of the following amino acid side chains has the highest pK_a value?
(A) Asp (B) Tyr (C) Cys (D) His (E) Glu
- (B) 17. In the active site of chymotrypsin, which of the following is the amino acid residue arrangement order of the catalytic triad?
(A) Asn...Lys...His (B) Asp...His...Ser (C) His...Asp...Tyr
(D) Asn...Ser...Cys (E) His...Cys...Asp
- (C) 18. Which of the following is a DNA sequence?
(A) Coactivator (B) Corepressor (C) Enhancer
(D) Inducer (E) Transactivator
- (D) 19. Poly-lysine exhibits a random coil structure at neutral pH. What kind of interaction can cause its formation of a random coil structure?
(A) Covalent bond (B) Hydrogen bond (C) van der Waals interaction
(D) Electrostatic interaction (E) Hydrophobic interaction
- (E) 20. Which one can not bind to the origin of replication of *E. coli* (*oriC*)?
(A) DnaA (B) DnaB (C) Integration host factor (IHF)
(D) Histone-like protein (HU) (E) Tus
- (B) 21. Which type of damage to DNA structure is most likely to be caused by UV light?
(A) Deamination (B) Pyrimidine dimers (C) Depurination
(D) Depyrimidination (E) Hydrolysis of the phosphodiester bond
- (E) 22. Which compound is an intermediate of the β -oxidation of fatty acids?
(A) $\text{CH}_3\text{---}(\text{CH}_2)_{20}\text{---CO---COOH}$
(B) $\text{CH}_3\text{---CH}_2\text{---CO---CH}_2\text{---CO---OPO}_3^{2-}$
(C) $\text{CH}_3\text{---CH}_2\text{---CO---CH}_2\text{---OH}$
(D) $\text{CH}_3\text{---CH}_2\text{---CO---CO---S---CoA}$
(E) $\text{CH}_3\text{---CO---CH---CO---S---CoA}$
- (A) 23. Which of the following enzymes requires coenzyme B_1 as cofactor?
(A) Pyruvate decarboxylase (B) Malic enzyme (C) Alcohol dehydrogenase
(D) Citrate synthase (E) Pyruvate carboxylase
- (E) 24. Which of the following statements is not correct?
(A) Bacterial peptidoglycan contains ($\beta 1 \rightarrow 4$) glycosidic linkage.
(B) Cellulose contains ($\beta 1 \rightarrow 4$) glycosidic linkage.
(C) Starch contains ($\alpha 1 \rightarrow 6$) glycosidic linkage.
(D) Glycogen contains ($\alpha 1 \rightarrow 4$) glycosidic linkage.
(E) Lactose contains ($\alpha 1 \rightarrow 4$) glycosidic linkage.
- (E) 25. For each molecule of acetyl-CoA that enters the citric acid cycle, which of the following sets represents the net products of the cycle?
(A) 2 CO_2 , 2 NADH, 2 FADH_2 , 1 GTP, 1 oxaloacetate
(B) 2 CO_2 , 3 NADH, 1 FADH_2 , 2 GTP, 1 oxaloacetate
(C) 2 CO_2 , 2 NADH, 1 FADH_2 , 2 GTP, 0 oxaloacetate
(D) 2 CO_2 , 3 NADH, 1 FADH_2 , 1 GTP, 1 oxaloacetate

- (E) 2 CO₂, 3 NADH, 1 FADH₂, 1 GTP, 0 oxaloacetate
- (C) 26. Fatty acids are activated to acyl-CoA, however, why the acyl group is further transferred to carnitine for β-oxidation?
 (A) Carnitine is required to oxidize NAD⁺ to NADH.
 (B) Acyl- CoAs easily cross the mitochondrial membrane, but the fatty acids themselves will not.
 (C) Acyl-carnitines readily cross the mitochondrial inner membrane, but acyl-CoAs do not.
 (D) Fatty acids cannot be oxidized by FAD unless they are in the acyl-carnitine form.
 (E) Carnitine can be oxidized to provide additional energy in mitochondria.
- (B) 27. Which of the following is the building block for the biosynthesis of phenylalanine, tyrosine, and tryptophan?
 (A) Pyruvate (B) Phosphoenolpyruvate (C) Acetyl-CoA
 (D) α-Ketoglutarate (E) Ribose-5-phosphate
- (B) 28. The reactions of citric acid cycle where CO₂ is produced are catalyzed by _____ and _____, respectively.
 (A) Isocitrate dehydrogenase; Malate dehydrogenase
 (B) Isocitrate dehydrogenase; α-ketoglutarate dehydrogenase
 (C) α-ketoglutarate dehydrogenase; Succinate dehydrogenase
 (D) α-ketoglutarate dehydrogenase; Malate dehydrogenase
 (E) Succinate dehydrogenase; Malate dehydrogenase
- (C) 29. Which of the following is false regarding the oxidation of 1 mole of palmitate (16:0) by the β-oxidation pathway?
 (A) 1 mole of ATP is needed. (B) 8 moles of acetyl-CoA are formed.
 (C) 8 moles of FADH₂ are formed. (D) AMP and PPi are formed.
 (E) The reactions occur in the mitochondria.
- (E) 30. What is the source of the polar head group in the formation of sphingomyelin?
 (A) CDP-choline (B) Phosphocholine (C) Cardiolipin
 (D) Phosphoserine (E) Phosphatidylcholine
- II. 【單選題】每題 2 分，共計 120 分。答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。
 31~60 題為普通生物學，61~90 題為生化概論。
- (C) 61. If a drug that specifically prevents the interaction of cytochrome *c* with other proteins is added to respiring mitochondria in a test tube, what effects would be observed?
 (A) ATP synthesis would be immediately stopped.
 (B) Oxygen consumption would increase.
 (C) Reduced cofactors (NADH/FADH₂) would be accumulated.
 (D) Coenzyme Q would be oxidized.
 (E) Proton export from the matrix would increase.
- (C) 62. If glucose is labeled with ¹⁴C at C-5, which of the following compounds can be found in TCA cycle first?
 (A) Malate labeled with ¹⁴C at C-2.
 (B) Isocitrate labeled with ¹⁴C at C-2.
 (C) α-Ketoglutarate labeled with ¹⁴C at C-5.
 (D) Citrate labeled with ¹⁴C at C-3.
 (E) Succinyl-CoA labeled with ¹⁴C at C-1.
- (E) 63. Which of the following can not transport proton across mitochondria inner membrane?
 (A) 2,4-Dinitrophenol (B) Thermogenin (C) ATPase
 (D) NADH dehydrogenase complex (E) QH₂ oxidase

- (D) 64. Which complex in the electron-transport chain contains copper ions?
 (A) Complex I (B) Complex II (C) Complex III (D) Complex IV
 (E) None of these complexes contains copper ions.
- (C) 65. Pyruvate is oxidized to produce _____, which further reacts with _____ to produce _____ during the citric acid cycle.
 (A) citrate; fumarate; α -ketoglutarate (B) citrate; isocitrate; α -ketoglutarate
 (C) acetyl-CoA; oxaloacetate; citrate (D) acetyl-CoA; malate; oxaloacetate
 (E) malate; citrate; acetyl-CoA
- (B) 66. Phosphate (Pi) is transported into the mitochondria from the cytosol by a phosphate carrier which is driven by the _____.
 (A) hydrolysis of ATP
 (B) simultaneous transport of H^+ into the mitochondrion
 (C) simultaneous transport of ADP into the mitochondrion
 (D) simultaneous transport of H^+ out of the mitochondrion
 (E) simultaneous transport of ATP out of the mitochondrion
- (D) 67. When monosaccharide dissolves in water at $40^\circ C$, it can undergo interconversion between α and β forms automatically. Which of the following regarding the amount of each form is correct after equilibrium?
 (A) β -D-Ribofuranose > β -D-Ribopyranose
 (B) α -D-Fructofuranose > β -D-Fructofuranose
 (C) β -D-Fructofuranose > β -D-Fructopyranose
 (D) β -D-Glucopyranose > α -D-Glucopyranose
 (E) None of the above
- (D) 68. Phospholipase C hydrolyzes phosphatidylinositol 4,5-bisphosphate (PIP₂) to form which signaling molecule that triggers Ca^{2+} release from the endoplasmic reticulum?
 (A) Diacylglycerolphosphate (DAGP) (B) Inositol 5-monophosphate (IP1)
 (C) Diacylglycerol (DAG) (D) Inositol 1,4,5-triphosphate (IP3)
 (E) Inositol 4,5-bisphosphate (IP2)
- (A) 69. Topoisomerases:
 (A) can change the linking number in increments of 1 or 2.
 (B) can act on single-stranded DNA circles.
 (C) change the degree of supercoiling of a DNA molecule but not its linking number of DNA.
 (D) occur in bacteria, but not in eukaryotes.
 (E) always require energy from ATP.
- (B) 70. The ion channel that opens in response to acetylcholine is an example of a _____ signal transduction system.
 (A) G-protein (B) ligand-gated (C) receptor-enzyme
 (D) serpentine receptor (E) voltage-gated
- (D) 71. The energy of a photon absorbed by an antenna molecule of the photosystem finds its way to a chlorophyll molecule in the reaction center of a light-harvesting complex by a process of _____. Which of the following is the best choice?
 (A) electron transfer (B) fluorescence re-radiation
 (C) resonance transfer (D) resonance transfer and electron transfer
 (E) electron transfer and fluorescence re-radiation
- (C)(D) 72. In the erythrocyte, glycolysis produces _____ that is further metabolized to _____.
 (A) lactate; acetyl-CoA (B) lactate; pyruvate (C) pyruvate; acetyl-CoA
 (D) pyruvate; lactate (E) pyruvate; oxaloacetate

- (B) 73. What role does AP endonuclease have in the base-excision repair system?
 (A) It removes the damaged base from the nucleic acid.
 (B) It cleaves the phosphodiester backbone after base removal.
 (C) It removes nucleotides from the broken strand of the nucleic acid.
 (D) It adds new nucleotides to replace the excised ones.
 (E) It creates a new phosphodiester bond to repair the backbone.
- (D) 74. Restriction-modification systems:
 (A) exist in all organisms as a protection against foreign DNA invasion.
 (B) include a site-specific exonuclease to degrade foreign DNA.
 (C) modify DNA by acetylation.
 (D) include a DNA methylase and an endonuclease.
 (E) include three types of endonuclease all of which cleave within a specific DNA target sequence.
- (B) 75. DNA polymerase I synthesizes new DNA with very high fidelity, due to its _____.
 (A) high processivity (B) 3'→5' exonuclease activity
 (C) helicase association with the primase (D) 5'→3' exonuclease activity
 (E) all of the above
- (C)(D)76. Which of the following is related to the function of proofreading step?
 (A) Riboswitch (B) EF-G in protein synthesis
 (C) Synthesis of aminoacyl-tRNA (D) RNA polymerase
 (E) None of the above
- (E) 77. Which of the following is least related with RNA interference?
 (A) RISC (B) Drosha (C) Dicer (D) miRNA (E) snRNA
- (D) 78. What acts as the nucleophile in the mechanism of nucleotide addition by RNA polymerase?
 (A) The 5' phosphate of an incoming nucleotide
 (B) A water molecule
 (C) A 5' hydroxyl of the template DNA
 (D) A 3' hydroxyl from the RNA being extended
 (E) An aspartate in the active site
- (A) 79. What type of mutation causes conditions such as Huntington's disease and Fragile X syndrome?
 (A) An excess of trinucleotide repeats in a protein-coding gene
 (B) A mutation in the p53 tumor suppressor
 (C) A mutation in a cyclin-dependent protein kinase
 (D) A mutation in the retinoblastoma gene
 (E) A mutation in caspase-activated DNase
- (C) 80. The photosynthetic electron transport system includes the transmembrane complexes PSI, PSII and _____.
 (A) PSIII (B) cytochrome a_3 (C) cytochrome b_6f
 (D) cytochrome c (E) proton translocating ATP synthase
- (A) 81. The analysis of enzyme kinetics using steady-state methods:
 (A) assumes $d[ES]/dt = 0$.
 (B) provides an accurate description of the reactions at all times.
 (C) can only be used if the product does not inhibit the enzyme.
 (D) cannot be applied when inhibitors are present.
 (E) can only be used if the substrate does not inhibit the enzyme.

- (E) 82. Which of these statements about enzyme-catalyzed reactions is false?
 (A) The V_{\max} of a reaction can be attained at saturated concentration of substrate, even in the presence of a competitive inhibitor.
 (B) At saturating levels of substrate, the rate of an enzyme-catalyzed reaction is proportional to the enzyme concentration.
 (C) The rate of a reaction decreases steadily with time as substrate is depleted.
 (D) The Michaelis-Menten constant K_m equals the $[S]$ at which $v = 1/2 V_{\max}$.
 (E) The activation energy for the catalyzed reaction is the same as for the uncatalyzed reaction, but the equilibrium constant is more favorable in the enzyme-catalyzed reaction.
- (D) 83. Which of the polypeptide is most likely to form a collagen structure?
 (A) IQEVERDIQEVERDIQEVERD (B) SRAGNRKIVLETW
 (C) TEDNFPAGKSILF (D) GAPGSPGPSGAP
 (E) NKASVEMAIRNGS
- (C) 84. Which of the following is false regarding 2,3-bisphosphoglycerate (BPG)?
 (A) It binds at a distance from the heme groups of hemoglobin.
 (B) It binds with lower affinity to fetal hemoglobin than to adult hemoglobin.
 (C) It increases the affinity of hemoglobin for oxygen.
 (D) It is an allosteric modulator of hemoglobin.
 (E) It is normally found associated with the hemoglobin extracted from red blood cells.
- (A) 85. Proline residues are infrequently found in _____ due to their _____.
 (A) helices. decreased ability to serve as hydrogen-bond donors
 (B) helices. large positive charge that disrupts the repeating structure
 (C) sheets. decreased ability to serve as hydrogen-bond donors
 (D) sheets. large positive charge that disrupts the repeating structure
 (E) turns. decreased flexibility as an amino acid
- (D) 86. When oxygen is bound to myoglobin, the amino acid _____ is complexed to the iron ion of the heme group while _____ forms a hydrogen bond to the oxygen.
 (A) cysteine; serine (B) cysteine; histidine (C) serine; cysteine
 (D) histidine; histidine (E) histidine; cysteine
- (A) 87. Which of the following is associated for determining the dihedral angle (phi) of the peptide bonds?
 (A) $C_O-N_H-C_\alpha-C_O$ (B) $N_H-C_\alpha-C_O-N_H$ (C) $C_\alpha-C_O-N_H-C_\alpha$
 (D) $H_N-C_\alpha-C_O-N_H$ (E) $H_\alpha-C_O-N_H-H_\alpha$
- (D) 88. The PCR reaction mixture does not include _____.
 (A) all four deoxynucleoside triphosphates
 (B) DNA containing the sequence to be amplified
 (C) heat-stable DNA polymerase
 (D) DNA ligase
 (E) oligonucleotide primer(s)
- (C) 89. Which of the following nuclear-encoded protein does not require signal peptide?
 (A) Secreted protein (B) Mitochondrial protein
 (C) Cytosolic protein (D) Plasma membrane protein
 (E) All of the above require signal peptide
- (D) 90. Which of the following techniques is the best to quantify protein-protein interactions?
 (A) Co-immunoprecipitation (B) Affinity chromatography
 (C) Chemical cross-linking (D) Surface plasmon resonance
 (E) The two-hybrid system

生 化

莊老師(施政安)老師提供

一、試題評析

1. 總體分析：

- (1) 本次試題偏易，都是莊老師上課再三強調之內容。
- (2) 除第 71、80 兩題光合作用題目是屬生物範疇，第 90 題屬專業實驗題外，以及第 79 題是專業遺傳疾病外，一律皆在講義或一般教科書都能找到。
- (3) 依純粹生化試題共 43 題來計算：基礎篇(15 題)、代謝篇(15 題)及分子生物篇(13 題) 各約占 1/3。

2. 題目分佈：

(1) 基礎篇：

Proteins and Amino acids : 第 16, 19, 83, 85, 87 題
 Nucleic acids : 第 69 題
 Carbohydrate : 第 24, 67 題
 Lipid : 第 68 題
 Enzymes and Kinetics : 第 17, 81, 82, 84 題
 Membrane : 第 70 題
 Hemoglobin and Myoglobin : 第 86 題

(2) 代謝篇：

Amino acids : 第 27 題
 Nucleic acids : 無
 Carbohydrate : 第 23, 72 題
 Lipid : 第 22, 26, 29, 30 題
 TCA cycle : 第 25, 28, 62, 65 題
 Electron transfer chain : 第 61, 63, 64, 66 題

(3) 分子生物篇：

Replication : 第 20, 75 題
 Repair : 第 21, 73, 75, 79 題
 Transcription : 第 18, 78 題
 Translation : 第 76, 89 題
 技術 : 第 74, 88, 90 題
 RNAi : 第 77 題

3. 解答在講義何處：

題 號	講 義 回 數	頁 數
16	第一回	p.30
17	第二回	p.183
18	第六回	p.118
19	第一回	p.251
20	第六回	p.46

題號	講義回數	頁數
21	第六回	P.84
22	第四回	p.189
23	第四回	p.14
24	第三回	p.77
25	第四回	p.34
26	第四回	p.190
27	第四回	p.130
28	第四回	p.23
29	第四回	p.242
30	第四回	p.277
61	第四回	p.64, 67
62	第四回	p.30, 34
63	第四回	p.56, 61
64	第四回	p.61
65	第四回	p.23
66	第四回	p.55
67	第三回	p.51
68	第三回	p.130
69	第三回	p.4
70	第五回	p.96
71	光合作用	
72	第三回	p.168
73	第六回	p.89
74	第六回	p.246
75	第六回	p.35
76	第六回	p.164
77	第六回	p.232
78	第六回	p.124
79	遺傳疾病	
80	光合作用	
81	第二回	p.123
82	第二回	p.168, 170
83	第一回	p.289
84	第二回	p.119
85	第一回	p.260
86	第二回	p.99
87	第一回	p.254
88	第六回	p.239
89	第六回	p.200, 201
90	專業實驗	

二、試題詳解

16.

Amino acids	pK_R
(A) Asp	3.65
(B) Tyr	10.07
(C) Cys	8.18
(D) His	6.0
(E) Glu	4.25

From : Lehniger's principles of biochemistry, 2017, 7th edition ,page77

17. Catalytic triad in serine peptidase : Serine-Histidine-Aspartate

18.

名詞	本質
(A) Coactivator	Protein
(B) Corepressor	Protein
(C) Enhancer	DNA
(D) Inducer	Metabolite (eg. Allolactose)
(E) Transactivator	Protein

19. pK_R of Lysine : 10.5, 所以在pH 7.0 當下Lys呈(+1)電荷分子, 故正正排斥導致產生random coil結構, 此力為electrostatic interaction (eg. ionic bond or salt bridge)

20. *Tus* is used in termination of replication.

21. UV induces pyrimidine dimers

22. β -oxidation是指 在 β 碳 或3號碳上發生氧化, 所以選(E), 但(E)少畫 1個H

23. TPP-contained enzymes :

Pyruvate dehydrogenase complex (in E2)

Pyruvate decarboxylase (in alcohol fermentation)

 α -ketoglutarate dehydrogenase complex (in E2)BCAA α -keto acid dehydrogenase complex (in E2)24. (E) $\beta 1 \rightarrow 4$

25. TCA cycle不會產生oxaloacetate, 只會氧化acetyl-CoA成 $2CO_2$ 及 能量分子 (3NADH + 1FADH₂ + 1GTP)

26. LCFA需要藉由carnitine shuttle才能進入mitochondria內燃燒

27. Erythrose-4-phosphate + Phosphoenolpyruvate $\rightarrow\rightarrow\rightarrow$ Phe, Tyr, and Trp
28. 產生CO₂的步驟在step3 isocitrate dehydrogenase 及 step4 α -ketoglutarate dehydrogenase complex
29. Palmitate (C16) + 1ATP + CoA \rightarrow 8acetyl-CoA + 7NADH + 7 FADH₂ + AMP + PPi
30. Phosphatidylcholine
61. 阻斷電子傳遞所以會導致NADH 和FADH₂堆積
62. Glucose (¹⁴C-5) \rightarrow Pyruvate (¹⁴C-2) \rightarrow Acetyl-CoA (¹⁴C-1) \rightarrow Citrate (¹⁴C-1 or ¹⁴C-5) \rightarrow Isocitrate (¹⁴C-5) \rightarrow α -ketoglutarate (¹⁴C-5)
64. Complex IV 內含Cu²⁺
66. H⁺ and Pi : antiporter
67. The pyranose is stable than the furanose.
68. PLC
 PIP₂ \rightarrow DAG \rightarrow activate PKC
 +
 IP₃ \rightarrow activate IP₃ receptor \rightarrow release of Ca²⁺ from ER
69. Topoisomerase依 ΔLk 值變化分成兩大類：
 Type I ($\Delta Lk = \text{one unit}$) and Type II ($\Delta Lk = \text{two unit}$)