生　化

莊老師(施政安)提供

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. An enzyme with a high turnover number has_____.
(A) a low K_m (B) a high k_{cat} (C) a high V_{max} (D) a high k_{cat}/K_m (E) a high K_m

(D) 17. Which of the following descriptions for myoglobin is **correct**?
(A) Myoglobin contains four subunits.
(B) The binding of O_2 with myoglobin shows cooperative kinetic.
(C) O_2 binds with Fe^{3+} of heme group in myoglobin.
(D) 2,3-BPG does not affect the binding of O_2 with myoglobin.
(E) Myoglobin and hemoglobin are not evolutionarily related.

(D) 18. Which of the following parts of the IgG molecule are **not** involved in binding to an antigen?
(A) Heavy chain (B) Light chain (C) Fab (D) Fc (E) Variable domain

(C) 19. Aspirin is well-known as an inhibitor of_____.
(A) lipoxygenase (B) hormone sensitive lipase (C) cyclooxygenase
(D) fatty acid synthase (E) acetyl-CoA carboxylase

(E) 20. Which is **not** derived from arachidonic acid?
(A) lipoxin (B) prostaglandin (C) thromboxane (D) leukotriene (E) prednisone

(E) 21. In fatty acid synthesis, acetyl group is shuttled out of mitochondria as:
(A) pyruvate (B) oxaloacetate (C) α-ketoglutarate (D) glutamine (E) citrate

(B) 22. Which of the metabolites in the urea cycle is linked to the citric acid cycle?
(A) Citrulline (B) Argininosuccinate (C) Arginine (D) Ornithine (E) Urea

(D) 23. Which of the following amino acids is the crucial precursor for the biosynthesis of melatonin?
(A) Phenylalanine (B) Methionine (C) Lysine (D) Tryptophan (E) Tyrosine

(E) 24. Which is **not** an electron acceptor in the mitochondrial respiratory chain?
(A) FMN (B) FAD (C) Fe^{3+} (D) Cu^{2+} (E) Coenzyme A

(C) 25. Which is the active sugar in glycogen synthesis in animal?
(A) CDP-glucose (B) GDP-glucose (C) UDP-glucose
(D) Glucose 6-phosphate (E) Glucose 1-phosphate

(A) 26. Which of the following compounds is **not** a product of the enzymatic steps in the citric acid cycle?
(A) Acetyl-CoA (B) α-ketoglutarate (C) Succinate (D) Fumarate (E) Malate

(B) 27. Gout is caused by aberrant degradation of purine, leading to accumulation of uric acid. Allopurinol inhibits_____, leading to reduce the production of uric acid.
(A) purine nucleoside phosphorylase
(B) xanthine oxidase
(C) nucleotidase
(D) urease
(E) hypoxanthine-guanine phosphoribosyltransferasse

(D) 28. Which of the following enzymes **cannot** catalyze the formation of a phosphodiester bond?
(A) RNA polymerase (B) DNA polymerase (C) Ligase
(D) Endonuclease (E) Reverse transcriptase

(A) 29. Histones are found in eukaryotic cell nuclei that package and order the DNA into structural units called nucleosomes. They are usually rich in _____, and they interact with DNA via _____.
(A) lysine and arginine; ionic bonds
(B) glutamic acid and aspartic acid; hydrogen bonds
(C) alanine and glycine; ionic bonds
(D) lysine and arginine; hydrogen bonds
(E) glutamic acid and aspartic acid; ionic bonds

(B) 30. The binding of _____ with *lac* repressor can activate the transcription of *lac* operon.
(A) arabinose (B) isopropyl β-thiogalactoside (C) tryptophan
(D) β-galactosidase (E) mannose

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。

(B) 61. A mixture of four amino acids is separated by using a cation exchanger with an elution gradient of increasing NaCl solution. What is the correct elution sequence?
(A) Asp, Lys, Arg, Ser (B) Asp, Ser, Lys, Arg (C) Asp, Arg, Ser, Lys
(D) Ser, Asp, Arg, Lys (E) Lys, Arg, Ser, Asp

(B) 62. For an α-helix has the sequence : $^{+}H_3N$-Asp-Trp-Gln-Leu-His-Val-Phe-Ala-Lys-Val-Glu-COO^{-}, the carbonyl oxygen (in the peptide bond) of the histidine residue is hydrogen bonded to the amide nitrogen of _____.
(A) Trp (B) Lys (C) Val (D) Gln (E) Leu

(D) 63. The carbohydrate moiety is always attached to glycoproteins through _____.
(A) aspartate, glutamate or tyrosine (B) tryptophan, glutamine or alanine
(C) cysteine, phenylalanine or histidine (D) asparagine, serine or threonine
(E) valine, leucine or isoleucine

(E) 64. Which of the backbone repeated units of polysaccharides is **not** correct?
(A) Amylose: (α1-4) Glc (B) Dextran: (α1-6) Glc (C) Glycogen: (α1-4) Glc
(D) Cellulose: (β1-4) Glc (E) Chitin: (β1-4) Glc

(E) 65. Taking one mole of glucose through glycolysis and the citric acid cycle generates:
(A) 6 CO_2, 8 $NADH/H^+$, 1 $FADH_2$ and 1 ATP
(B) 6 CO_2, 8 $NADH/H^+$, 1 $FADH_2$ and 2 ATP
(C) 6 CO_2, 8 $NADH/H^+$, 2 $FADH_2$ and 4 ATP
(D) 6 CO_2, 10 $NADH/H^+$, 2 $FADH_2$ and 2 ATP
(E) 6 CO_2, 10 $NADH/H^+$, 2 $FADH_2$ and 4 ATP

(D) 66. Which of the following is a hetero-polysaccharide?
(A) Cellulose (B) Chitin (C) Glycogen (D) Hyaluronate (E) Starch

(E) 67. Glycoaminoglycans consist of a linear chain of repeating disaccharides. Which of the following polysaccharide is **not** glycoaminoglycans?
(A) Chondroitin sulfate (B) Keratan sulfate (C) Dermatan sulfate
(D) Heparin (E) Sialic acid

(C) 68. Gluconeogenesis synthesizes glucose, while glycolysis catabolizes glucose. It is evident that gluconeogenesis and glycolysis must be controlled in reciprocal fashion. Which of the following enzymes for glycolysis are **not** used in the gluconeogenic pathway? ① Hexokinase ② Phosphofructokinase ③ Phosphoglycerate kinase ④ Triosephosphate isomerase ⑤ Pyruvate kinase
(A) ①②③ (B) ①②④ (C) ①②⑤ (D) ②③⑤ (E) ③④⑤

(D) 69. The potent allosteric activator for phosphofructokinase-1 in glycolysis is _____.
(A) fructose 1,6-bisphosphate (B) citrate (C) ATP
(D) fructose 2,6-bisphosphate (E) acetyl-CoA

(A) 70. Which of the following compounds can prevent electron transfer from the Fe-S center to ubiquinone in oxidative phosphorylation process?
(A) Rotenone (B) Cyanide (C) 2,4-Dintrophenol (D) Oligomycin (E) Valinomycin

(A) 71. Which of the following fatty acids **cannot** be synthesized by human?
(A) Linoleate [18:2($\Delta^{9,12}$)] (B) Stearate (18:0) (C) Oleate [18:1(Δ^{9})]
(D) Palmitoleate [16:1(Δ^{9})] (E) Arachidonate [20:4($\Delta^{5,8,11,14}$)]

(D) 72. Ketone bodies are overproduced in diabetes and during starvation. Which of the following metabolites is **not** an intermediate from two molecules of acetyl-CoA to acetone?
(A) Acetoacetyl-CoA (B) β-hydroxy-β-methylglutaryl-CoA (C) Acetoacetate
(D) β-hydroxybutyrate (E) CoA-SH

(C) 73. Which is **not** involved in fatty acid oxidation?
(A) Starts from carboxylate end
(B) Acyl-CoA dehydrogenase
(C) Acyl-CoA hydratase
(D) β-hydroxyacyl-CoA dehydrogenase
(E) Acyl-CoA acetyltransferase

(C) 74. Which is the potent inhibitor of carnitine acyltransferase I?
(A) Carnitine (B) Acetyl-CoA (C) Malonyl-CoA (D) Succinyl-CoA (E) Fumarate

(A) 75. Flippases are enzymes that flip _____.
(A) phospholipids across to the other side of a membrane
(B) cholesterol from one organelle to another
(C) protons across to the other side of a membrane
(D) D-glucose to L-glucose
(E) L-form amino acids to D-form amino acids

(E) 76. Degradation of amino acids can produce the precursors that are used to synthesize glucose or convert to ketone bodies. Which of the following amino acids can convert into precursors for the synthesis of glucose?
① Leucine ② Lysine ③ Cysteine ④ Asparagine ⑤ Methionine
(A) ①②③ (B) ①②④ (C) ②③④ (D) ②④⑤ (E) ③④⑤

(C) 77. A deficiency of branched chain α-keto acid dehydrogenease complex causes the defect in metabolism of amino acids. The accumulation of α-keto acid in urine leads to maple syrup urine disease. Which of the following amino acids are metabolized by α-keto acid dehydrogenease complex?
① Methionine ② Leucine ③ Isoleucine ④ Valine ⑤ Alanine
(A) ①②⑤ (B) ①③⑤ (C) ②③④ (D) ②④⑤ (E) ③④⑤

(B) 78. Defect in metabolism of phenylalanine causes phenylketounia and alkaptonuria. Which of the following statements are **correct**? ① A person with phenylketonuria will convert phenylalanine to phenylpyruvate. ② A person suffering from phenylketonuria on consumption food containing high phenylalanine may lead to the accumulation of tyrosine. ③ A person with phenylketonuria is advised not to consume aspartame. ④ Alkaptonuria is due to defect in phenylalanine hydroxylase. ⑤ A person suffering from phenylketonuria on consumption food containing high phenylalanine may lead to the accumulation of acetoacetyl-CoA.
(A) ①② (B) ①③ (C) ①④ (D) ②③ (E) ②⑤

(C) 79. The *de novo* purine nucleotide synthesis relies upon the conversion of _____ to _____as a primary source of one carbon unit.
(A) alanine; pyruvate (B) phenylalanine; tyrosine (C) serine; glycine
(D) glutamate; α-ketoglutarate (E) aspartate; oxaloacetate

(E) 80. Which of the following statements for thermal denatuation of DNA are **false**? ① The absorption of ultraviolet at 260 nm increases. ② The DNA helical structure unwinds. ③ The covalent N-glycosidic bond between the base and the deoxyribose breaks. ④ The melting temperature of DNA with 60% A+T content is lower than that with 20% G+C content. ⑤ The double-helical DNA becomes single-stranded DNA at melting temperature.
(A) ①③⑤ (B) ①③④ (C) ①④⑤ (D) ②③④ (E) ③④⑤

(C) 81. Which of the following enzymes does **not** require a template?
(A) RNA polymerase II (B) DNA polymerase
(C) Polyadenylate polymerase (D) Telomerase
(E) Reverse transcriptase

(B) 82. Which is **not** a true statement about reverse transcriptase?
(A) The direction of polynucleotide synthesis is 5' → 3'.
(B) It has 3' → 5' exonuclease activity.
(C) It synthesizes DNA complementary to an RNA template.
(D) It synthesizes DNA complementary to a DNA template.
(E) It degrades the RNA strand of the RNA-DNA hybrid.

(D) 83. Many proteins are involved in DNA replication of *E. coli*. Which of the following pairs of protein and function are **correct**? ① DNA gyrase, unwinding DNA ② DnaA, helicase ③ DNA polymerase I, excises RNA primer and fills in with DNA ④ DNA polymerase II holoenzyme, 5' → 3' exonuclease ⑤ DNA polymerase III holoenzyme, elongation (DNA synthesis)
(A) ②③⑤ (B) ②③④ (C) ①③④ (D) ①③⑤ (E) ①②⑤

(A) 84. Which DNA repair system is likely to be used in repairing DNA with an uracil residue?
(A) Base-excision repair (B) Mismatch repair (C) Direct repair
(D) Nucleotide-excision repair (E) Recombinational DNA repair

(C) 85. Aptamers are _____.
(A) double-stranded RNA products of nuclease action on hairpin RNAs
(B) repeat sequence elements at the ends of transposons
(C) small RNA molecules selected for tight binding to specific molecular targets
(D) the RNA primers required for retroviral replication
(E) the short tandem repeat units found in telomeres

(C) 86. Which of the following modification elucidates the inhibitory effect of diphtheria toxin on the function of eukaryotic translation factor eEF2?
(A) Phosphorylation (B) Dephosphorylation (C) ADP-ribosylation (D) Prenylation (E) S-Nitrosylation

(C) 87. Elongation factor Tu (EF-Tu):
(A) binds GTP promoting translocation of ribosomes along mRNA
(B) displaces GDP from the elongation complex
(C) binds aminoacyl-tRNA in the presence of GTP
(D) binds initiator tRNA and GTP
(E) binds to 30S subunit and drives mRNA binding

(B) 88. Selenocysteine (Sec) and pyrrolysine (Pyl) are recognized as 21st and 22nd amino acids, respectively. $tRNA^{Sec}$ and $tRNA^{Pyl}$ have anticodon pairing with _____ and _____, respectively.
(A) UAA, CUG (B) UGA, UAG (C) UAA, UAG (D) UAG, UGA (E) UAG, UAA

(B) 89. Which step about regulation of gene expression by insulin is **not** correct?
(A) Insulin receptor binds insulin and undergoes autophosphorylation.
(B) Insulin receptor binds IRS-1 on its Tyr residues. SH3 domain of Grb2 binds to phosphorylated Tyr of IRS-1.
(C) Sos binds to Grb2, then to Ras, causing GDP release and GTP binding to Ras.
(D) Activated Ras binds and activates Raf-1.
(E) Raf-1 phosphorylates MEK. MEK phosphorylates MAPK, activating it.

(D) 90. Which description about β-adrenergic pathway (a G-protein coupling receptor; GPCR) is **not** correct?
(A) The receptor is a 7-transmembrane protein.
(B) Epinephrine binds to a GPCR.
(C) The occupied receptor could cause the replacement of the GDP bound to G_S (stimulatory G protein) by GTP, activating G_S.
(D) $G_{S\beta}$ moves to adenylyl cyclase and activates it to synthesize cAMP.
(E) cAMP activates PKA to trigger cellular response.

108 後醫生化試題解析

一、試題評析

1. 總體分析:

(1) 除了第 18 題是免疫學外, 其餘皆屬一般生物化學,在講義裡都可找到。

(2) 一般生物化學分三篇:

基礎篇 (佔 31%, 共 14 題),

代謝篇 (佔 47%, 共 21 題), 及

分子生物篇 (佔 20%, 共 9 題)

2. 題目分布:

(1) 基礎篇:

Proteins and Amino acids (第 61, 62, 63 及 88 題)

Nucleic acids (第 29 及 80 題)

Carbohydrates (第 64 及 67 題)

Lipids (第 66 題)

Myoglobin and Hemoglobin (第 17 題)

Membrane structure (第 75 題)

Signal transduction (第 89 及 90 題)

(2) 代謝篇:

Carbohydrates (第 25, 65, 68 及 69 題)

Amino acids (第 22, 23, 76, 77 及 78 題)

Lipids (第 19, 20, 21, 71, 72, 73 及 74 題)

Nucleic acids (第 27 及 79 題)

Citric acid cycle (第 26 題)

Electron transfer chain (第 24 及 70 題)

(3) 分子生物篇:

Replication (第 83 題)

Repair (第 84 題)

Translation (第 86 及 87 題)

Gene control (第 30 及 85 題)

Others (第 28, 81 及 82 題)

3. 解答在講義何處:

題號	教材回數	頁數
16	第二回	P.131
17	第二回	P.95
18	免疫學	
19	第四回	P.244
20	第四回	P.242
21	第四回	P.220
22	第四回	P.103
23	第四回	P.138 P.168
24	第四回	P.59～60
25	第三回	P.230
26	第四回	P.23
27	第四回	P.146
28	第六回	P.89
29	第三回	P.21
30	第六回	P.218
61	第一回	P.93
	第一次模考	第 24 題
62	第一回	P.247
	第一次模考	第 27 題
63	第三回	P.40
64	第三回	P.78

65	第四回	P.68
66	第三回	P.37 P.39
67	第三回	P.38 P.41
68	第三回	P.209
69	第四回	P.220
70	第四回	P.63～64
71	第四回	P.240
72	第四回	P.202
73	第四回	P.188
74	第四回	P.211
75	第五回	P.84
76	第四回	P.91
77	第四回	P.124
78	第四回	P.124
79	第四回	P.164
	試題解析(二)	第 8 題
80	第三回	P.33
81	第六回	P.155
82	上課筆記	
83	第六回	P.35 P.40 P.70
84	第六回	P.78 P.82
85	第六回	P.227
86	第六回	P.207
87	第六回	P.181
88	第一回	P.116
89	第五回	P.152
90	第五回	P.121 P.129

二、試題詳解

16. Turnover number = *K*cat (catalytic constant)

17. Myoglobin 是 monomer 所以不是 allosteric protein, 因此 2,3-BPG 不是 myoglobin 的 inhibitor; 反之 , hemoglobin 是 tetramer, 所以是 allosteric protein, 因此 2,3-BPG 是 hemoglobin 的 inhibitor 。

22. Argininosuccinate 裂解成 arginine 及 fumarate,再以 fumarate 進入 citric acid cycle。

23. Melatonin(褪黑激素) 不是 melanin(黑色素) 。
Tryptophan →→→ serotonin → melatonin;
Phenylalanine → tyrosine →→→ melanin;
所以答案是(D) tryptophan。

28. Endonuclease 是打斷 phosphodiester bond 。

29. DNA 本身帶負電荷(因含 phosphate)要和帶正電荷的 histone 結合 (histone protein 含大量帶正電荷的 lysine 或 arginine)

62. H-bond 是藉由第 n 個 amino acid 的 carbonyl group 的 O 和第 (n+4)個 amino acid 的 amino group 的 H 互相組成, 所以 histidine 是第 5 個 amino acid 要和第 9 個 amino acid (lysine) 組成 α-helix 的 H-bond。

63. Glycoprotein 有 N-linked 及 O-linked : N 是 asparagine 的 amide N ; O 是 serine 或 threonine 的氫氧基裡的氧(O)原子。

65. 考 glucose 完全氧化得多少能量分子, 雖然題目只說明經 glycolysis 及 citric acid cycle 之反應, 但 citric acid cycle 必需以 acetyl-CoA 方式進入, 因此必定有 pyruvate → acetyl-CoA 此反應:

Glucose → 2Pyruvate	$2NADH/H^+ + 2ATP$
2Pyruvate → $2Acetyl\text{-}CoA + 2CO_2$	$2NADH/H^+$
$2Acetyl\text{-}CoA \rightarrow 4CO_2$	$6NADHs + 2FADH_2 + 2GTP$
$6CO_2 +$	$10NADH/H^+ + 2FADH_2 + 2ATP + 2GTP$

因 GTP 能量等同 ATP, 故選(E) $6CO_2 + 10NADH/H^+ + 2FADH_2 + 4ATP$。

73. (C) enoyl-CoA hydratase 才對。至於(E) acyl-CoA acetyltransferase 就是指 thiolase (thiolase 是常用詞) 。

77. Maple syrup disease 是因 BCAA (branched-chain amino acids= valine, leucine and isoleucine)無法代謝之遺傳疾病。

79. Serine + tetrahydrofolate → Glycine + N^5,N^{10}-methylene- tetrahydrofolate 是 C1-unit 主要反應。

80. Denaturation:
    (3) DNA 不會裂解
    (4) DNA Tm 值和[G+C]%成正比例關係, 所以 40%[G+C] DNA 的 Tm 值 > 20%[G+C] 。

82. Reverse transcriptase 有三大功能:
    (1) RNA-dependent DNA polymerase(以 RNA 為 template 合成 DNA);
    (2) RNaseH (認 DNA/RNA hybrid 並將 RNA 部分分解之);
    (3) DNA-dependent DNA polymerase(以 DNA 為 template 合成 DNA); 但是卻缺乏 3'→ 5' exonuclease 的 proofreading function, 故 Reverse transcriptase 是屬於 error-prone polymerase。

88.

amino acid	codon
L-Selenocysteine	UGA
L-Pyrrolysine	UAG