

國立彰化師範大學 99 學年度碩士班招生考試試題

系所：生物學系

組別：乙組

科目：生物化學

☆☆請在答案紙上作答☆☆

共 5 頁，第 1 頁

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

- Which amino acids are produced from oxaloacetate?
 - lysine, serine, arginine
 - methionine, leucine, valine
 - aspartate, methionine, threonine
 - phenylalanine, tryptophan, tyrosine
 - phenylalanine, tyrosine, histidine
- The first committed step in fatty acid synthesis is:
 - The carboxylation of acetyl-CoA to form malonyl-CoA by the enzyme acetyl-CoA carboxylase.
 - The activation by the enzyme acyl-CoA synthetase to form a fatty acyl-CoA.
 - Attachment of the acyl group to carnitine by the enzyme carnitine acyltransferase I.
 - The condensation of acetyl-ACP and malonyl-ACP to form acetoacetyl-ACP.
 - Formation of acetyl-CoA from acetate.
- In one catalytic cycle, the Na⁺/K⁺ ATPase transporter transports:
 - 2 Na⁺ out, 3 K⁺ in, and converts 1 ATP to ADP + Pi.
 - 3 Na⁺ out, 2 K⁺ in, and converts 1 ATP to ADP + Pi.
 - 3 Na⁺ in, 2 K⁺ out, and converts 1 ATP to ADP + Pi.
 - 1 Na⁺ out, 1 K⁺ in, and converts 1 ATP to ADP + Pi.
 - 2 Na⁺ out, 3 K⁺ in, and converts 1 ADP + Pi to ATP.
- Which of the following hormones uses a nuclear receptor?
 - Insulin
 - Epinephrine
 - Parathyroid hormone
 - Glucocorticoid
 - Glucagon
- Which of the following statements about membrane lipids is true?
 - Glycerophospholipids are found only in the membranes of plant cells.
 - Glycerophospholipids contain fatty acids linked to glycerol through amide bonds.
 - Lecithin (phosphatidylcholine), which is used as an emulsifier in margarine and chocolate, is a sphingolipid.
 - Some sphingolipids include oligosaccharides in their structure.
 - Triacylglycerols are the principal components of erythrocyte membranes.
- Which of the following does not involve cyclic AMP?
 - Regulation of glycogen synthesis and breakdown
 - Regulation of glycolysis

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- (c) Signaling by acetylcholine
 - (d) Signaling by epinephrine
 - (e) Signaling by glucagon
7. A 30-carbon precursor of the steroid nucleus is:
- (a) Farnesyl pyrophosphate.
 - (b) Geranyl pyrophosphate.
 - (c) Isopentenyl pyrophosphate.
 - (d) Lysolecithin.
 - (e) Squalene.
8. Lipoprotein particles in human blood do not contain:
- (a) An apolipoprotein B isoform.
 - (b) Cholesterol.
 - (c) Cholesteryl esters.
 - (d) Lecithin.
 - (e) Triglycerides.
9. Which of the following statements about the fixation of atmospheric nitrogen (N_2) into NH_3 by living cells is false?
- (a) It involves the transfer of 8 electrons per mol of N_2 .
 - (b) It occurs in certain microorganisms, but not in humans.
 - (c) It requires a source of electrons, normally ferredoxin.
 - (d) It requires one ATP per mol of N_2 fixed.
 - (e) none of the above.
10. Which of the following is *not* true of the reaction producing malonyl-CoA during fatty acid synthesis?
- (a) It is stimulated by citrate.
 - (b) It requires acyl carrier protein (ACP).
 - (c) It requires CO_2 (or bicarbonate).
 - (d) One mole of ATP is converted to ADP + P_i for each malonyl-CoA synthesized.
 - (e) The cofactor is biotin.
11. In the synthesis of phosphatidylcholine from phosphatidylethanolamine, the methyl group donor is:
- (a) a tetrahydrofolate derivative.
 - (b) choline.
 - (c) methanol.
 - (d) *S*-adenosylmethionine (adoMet).
 - (e) serine.

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12. In its role in the hormonal hierarchy, the hypothalamus produces and releases:
- (a) epinephrine.
 - (b) insulin.
 - (c) progesterone.
 - (d) releasing factors.
 - (e) thyroxine.
13. Epinephrine triggers an increased rate of glycolysis in muscle by:
- (a) activation of hexokinase.
 - (b) activation of phosphofructokinase-1.
 - (c) conversion of glycogen phosphorylase a to glycogen phosphorylase b.
 - (d) inhibition of the Cori Cycle.
 - (e) the Pasteur effect.
14. Glutathione is a(n):
- (a) enzyme essential in the synthesis of glutamate.
 - (b) isomer of oxidized glutamic acid.
 - (c) methyl-group donor in many biosynthetic pathways.
 - (d) product of glutamate and methionine.
 - (e) tripeptide of glycine, glutamate, and cysteine.
15. Which of the following is *not* true of the reaction catalyzed by ribonucleotide reductase?
- (a) Glutathione is part of the path of electron transfer.
 - (b) It acts on nucleoside diphosphates.
 - (c) Its mechanism involves formation of a free radical.
 - (d) There is a separate enzyme for each nucleotide (ADP, CDP, GDP, UDP).
 - (e) Thioredoxin acts as an essential electron carrier.

II: 簡答題(每題 3%)

以碳水化合物為原料，經微生物(酵母菌或細菌)發酵產生酒精是目前運用規模最大的生質能技術，請寫出由葡萄糖發酵產生酒精的平衡化學反應式(不必寫出 ΔG)。(1)
葡萄糖的化學式為(2)，分子量為(3)，酒精的化學式為(4)，分子量為(5)。在酒精發酵的過程中，葡萄糖中的碳原子受到氧化或是還原？(6)酒精發酵、光合作用與呼吸作用均為能量代謝的方式，在厭氧條件下，每一個葡萄糖分子發酵成為酒精在酵母菌細胞內可產生(7)個ATP？若酵母菌將培養基中的葡萄糖完全轉變為酒精，則每克葡萄糖應可產生(8)克酒精？

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在一篇標題為 Towards bacterial strains overproducing L-tryptophan and other aromatics by metabolic engineering 的報告中有下列這一個圖：

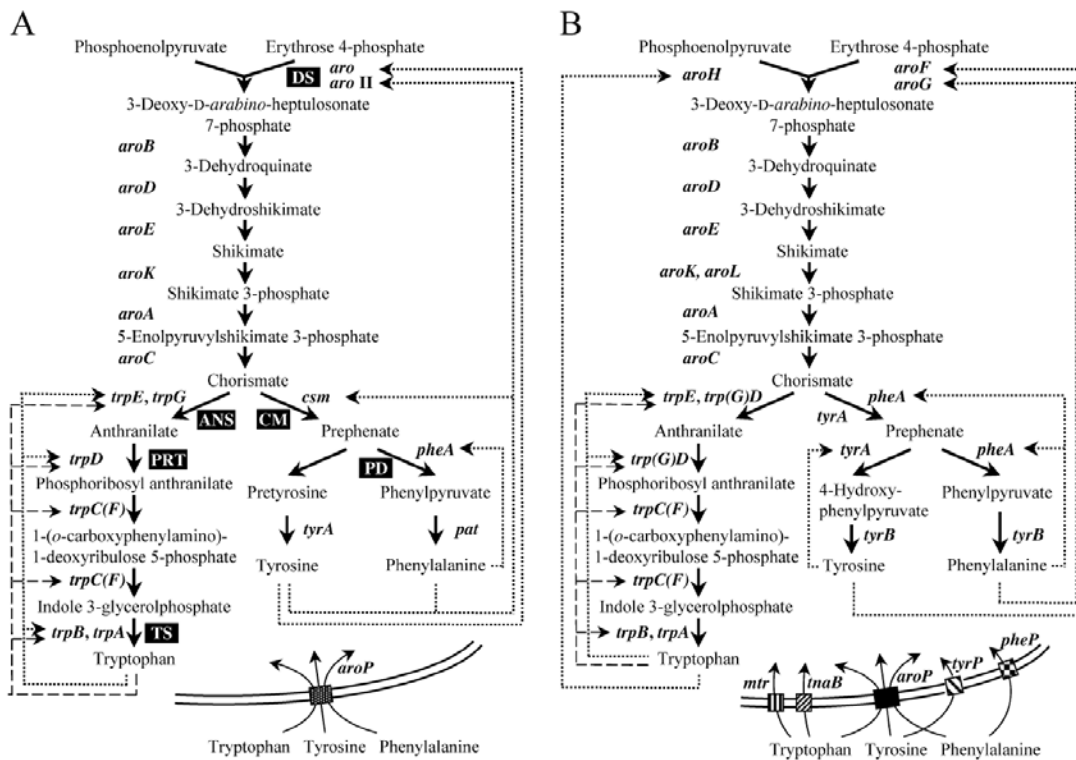


Fig. 1 Biosynthetic pathways, regulations, and transport systems of aromatic amino acids in *Corynebacterium glutamicum* (a) and *Escherichia coli* (b). The dotted lines and the dashed lines indicate feedback inhibition and repression, respectively. Symbols for genes

follow mostly the *E. coli* K-12 linkage map. DS 3-deoxy-D-arabino-heptulosonate 7-phosphate synthase, CM chorismate mutase, PD prephenate dehydratase, ANS anthranilate synthase, PRT anthranilate phosphoribosyltransferase, TS tryptophan synthase

依照圖的內容與圖說回答第 9-10 題(每題答對得 3%，答錯倒扣 1%)：

9. *C. glutamicum* 細胞內的 phenylalanine 含量升高時，下列哪一個酵素的活性會下降？

- I. 3-deoxy-D-arabino-heptulosonate 7-phosphate synthase
- II. anthranilate synthase
- III. prephenate dehydratase
- IV. chorismate mutase

(A)只有 I (B)只有 II (C)只有 III (D)只有 I 和 II (E)只有 I, III 和 IV

10. *Escherichia coli* 細胞內 tryptophan 含量升高時，下列哪一個酵素的活性會下降？

- I. 3-deoxy-D-arabino-heptulosonate 7-phosphate synthase
- II. anthranilate synthase
- III. prephenate dehydratase
- IV. chorismate mutase

(A)只有 I (B)只有 II (C)只有 I 和 II (D)只有 III 和 IV (E)I, II, III 和 IV

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III: (40%) (from Lehninger)

1. Why do amino acids, when dissolved in water, become zwitterions? (5%)
2. How can changes in pH alter the conformation of a protein? (5%)
3. How does BPG binding to hemoglobin decrease its affinity for oxygen? (6%)
4. Why does pH affect the activity of an enzyme? (6%)
5. Explain in molecular terms why humans cannot use cellulose as a nutrient, but goats and cattle can. (6%)
6. Write a double-stranded DNA sequence containing a six-nucleotide palindrome. (6%)
7. What are RFLPs and how are they used in forensic DNA fingerprinting technology? (6%)