

※注意：作答時，請於答案卷上標明作答之大題及其題號。

1-20 題為單選題，每題兩分，21-30 為問答題，每題分數標於題後。

Please include brief explanation for your answers if you are not sure about your choice. (如果沒有把握哪一個答案是對的，請針對你的選擇做說明，可能有助得分)

一 單選題

1. Which statement is false about most metabolic pathways:
 - A. Most pathways are reversible under physiological conditions
 - B. Pathways serve to increase the efficiency of energy transfers
 - C. The rates of pathway reactions vary to respond to changing conditions.
 - D. The enzymes that catalyze reactions in a pathway generally catalyze only a single step
2. During kinase reactions, the role of magnesium ions is to
 - A. be catalytic metals at the active sites of the enzymes.
 - B. interact with the hydroxyl groups of the various sugar molecules
 - C. interact with the negative charges on phosphate groups.
 - D. provide a bridging atom between substrate and product, stabilizing the transition state.
3. Which of the following cofactors is not found in or used by the pyruvate dehydrogenase complex?
 - A. FMN
 - B. NAD
 - C. lipoic acid
 - D. thiamine pyrophosphate
 - E. CoA
4. Which of the following enzymes carries out an anaplerotic (replenishing) reaction that produces citric-acid cycle intermediates?
 - A. pyruvate dehydrogenase kinase
 - B. malate synthase
 - C. acetate thiokinase
 - D. dihydrolipoamide dehydrogenase
5. Which enzyme in the citric-acid cycle catalyzes a substrate-level phosphorylation?
 - A. citrate synthase
 - B. isocitrate dehydrogenase
 - C. succinyl-CoA synthetase
 - D. fumarase
 - E. aconitase

6. What is the redox reaction that is ultimately the source of electrons for the production of NADH by the pyruvate dehydrogenase complex?
- A. the loss of CO_2 from pyruvate
 - B. the oxidation of HETPP (hydroxyethylthiamine pyrophosphate) to acetyl-TPP
 - C. the transfer of an acetyl group from TPP to dihydrolipoamide
 - D. the production of acetyl-CoA from acetyl-dihydrolipoamide and CoA
7. Glycolytic intermediates such as pyruvate and 3-phosphoglycerate can be converted into amino acids and other metabolites. This means that, like the citric-acid cycle, glycolysis is
- A. anabolic
 - B. catabolic
 - C. amphibolic
 - D. anaplerotic
8. Glucagon activates all of the following enzymes **except**
- A. glycogen synthase.
 - B. glycogen phosphorylase.
 - C. phosphorylase kinase.
 - D. protein kinase A.
9. The 6-phosphogluconate dehydrogenase step in the pentose phosphate pathway is mechanistically similar to
- A. glyceraldehyde-3-phosphate dehydrogenase.
 - B. isocitrate dehydrogenase.
 - C. glucose-6-phosphate dehydrogenase.
 - D. PEP carboxykinase.
10. What is the strongest reducing agent in photosynthetic electron-transfer reactions?
- A. P700
 - B. P700*
 - C. P680*
 - D. P680
 - E. plastoquinone
 - F. plastocyanin
11. Protein folding is entropically driven because:
- A. the entropy of the folded protein is less than that of the unfolded protein.
 - B. the entropy of the folded protein is greater than that of the unfolded protein.
 - C. the entropy of water molecules released from a folded protein is greater than the entropy of water molecules interacting with an unfolded protein.
 - D. the entropy of water molecules released from a folded protein is smaller than the entropy of water molecules interacting with an unfolded protein.

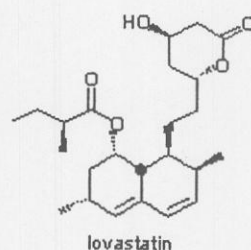
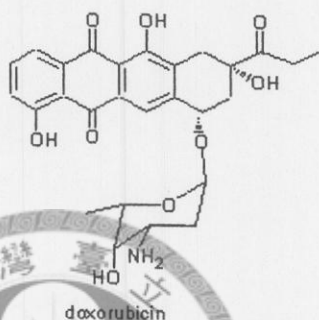
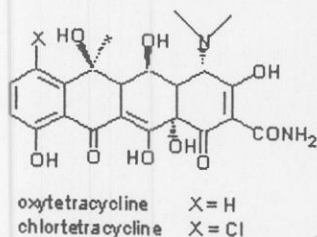
12. Which of the following proteins in the photosynthetic electron-transport chain is **not** a transmembrane protein?
- A. LHC (light harvesting complex)
 - B. ferredoxin
 - C. ATP synthase
 - D. PSI (photosystem I)
 - E. PSII
13. The reactions catalyzed by Rubisco can be summarized schematically as
- A. $C_6 \rightarrow 2 C_2 + CO_2$
 - B. $CO_2 + C_5 \rightarrow 2 C_3$
 - C. $3 C_5 \rightarrow C_3 + 2 C_6$
 - D. $C_6 + 3 C_3 \rightarrow 3 C_5$
14. What is the key regulatory step in cholesterol biosynthesis?
- A. mevalonate kinase
 - B. phosphomevalonate kinase
 - C. prenyl transferase
 - D. HMG-CoA reductase
 - E. isopentyl pyrophosphate isomerase
 - F. pyrophosphomevalonate decarboxylase
15. Which of the following compounds is **not** synthesized from isoprene precursors?
- A. Cholesterol
 - B. vitamin D
 - C. testosterone
 - D. gibberellin
 - E. ubiquinone
 - F. bilirubin
16. Nitric oxide is synthesized from which amino acid?
- A. Arginine
 - B. Lysine
 - C. Histidine
 - D. Tryptophan
17. Which of the following bases **cannot** be directly salvaged?
- A. Guanine
 - B. Hypoxanthine
 - C. Xanthine
 - D. Adenine

18. The first nucleotide product in the *de novo* biosynthetic pathways of purines is
- AMP
 - GMP
 - IMP
 - XMP
19. Which is a reasonable distance between coenzymes in electron transfer proteins?
- 1 Angstrom
 - 10 Angstroms
 - 100 nanometers
 - 1 micrometer
20. Microbes that can adjust their metabolism to the presence or absence of oxygen are called
- flexible anaerobes
 - obligate anaerobes
 - ambioxate anaerobes
 - facultative anaerobes

二 問答題

21. The metabolism mediated by enzymes within an organism is subject to diverse ways of regulation. Please discuss the major regulation modes or mechanisms for metabolisms you have learned before. (10%)
22. Please write all the major enzymes-catalyzed reactions that include "pyruvate" as substrate or products (at least five reactions in primary metabolisms). Please draw the chemical structures of pyruvate, and the major metabolites involved. Also, please state the physiological functions for the reactions. (10%)
23. Phosphorylation is an important way for enzyme regulation and for substrate modifications. Please discuss the structural effects for proteins or metabolites, which are subject to phosphorylation. Name at least two examples for each. (5%)
24. Please describe the characteristic of the reactions catalyzed by transketolase. Which coenzyme is required? Please list at least two metabolism pathways that include transketolase. (5%)
25. Please describe the definitions and characters of Cytochrome P450. (5%)
26. Please describe all the enzyme-catalyzed reactions that involved in the flow of "atmospheric nitrogen (N_2)" to glutamine in animals. (5%)
27. Glyoxylate cycle is active in oily seed plants. Please describe its physiological function and the reactions involved. (5%)

28. The following chemicals, generally called "polyketides", are synthesized by polyketide synthases, a group of enzymes that are related to fatty acid synthase in evolution (similar primary structure). The biosynthesis of fatty acid can be described as repeated cycles of **condensation, reduction, dehydration and second reduction**. Please propose possible ways that polyketide synthase evolved from fatty acid synthase to possess new functions. (5%)



29. Please define the meaning of "reverse genetics" and the tools/methods that may be used in this approach. (5%)
30. The following picture is obtained from "The Plant Cell" journal (Bishop and Koncz, 2002). This picture proposed three possible models for brassinosteroid (BL) signal transduction. The title for it is "Schematic Models Indicate a Central Role for BRI1 in BL Signaling". Please add a few lines as the legend (that is, to say something about the picture 就是稍微說一個小故事去說明). BRI1 is the membrane receptor for BL. RLK stands for receptor-like kinase. "P" stands for phosphorylation. (don't worry if you don't understand the abbreviations) (5%)

